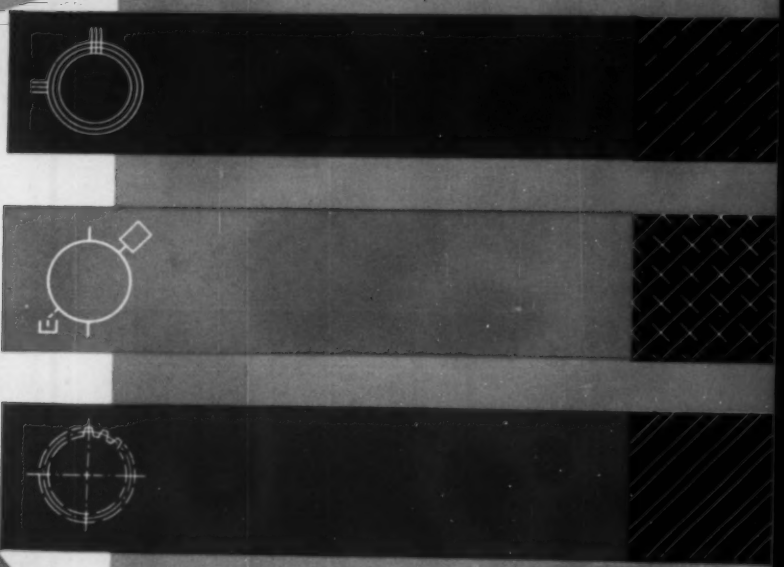
MAY 16, 1957

MACHINE DESIGN

A PENTON PUBLICATION — BIWEEKLY



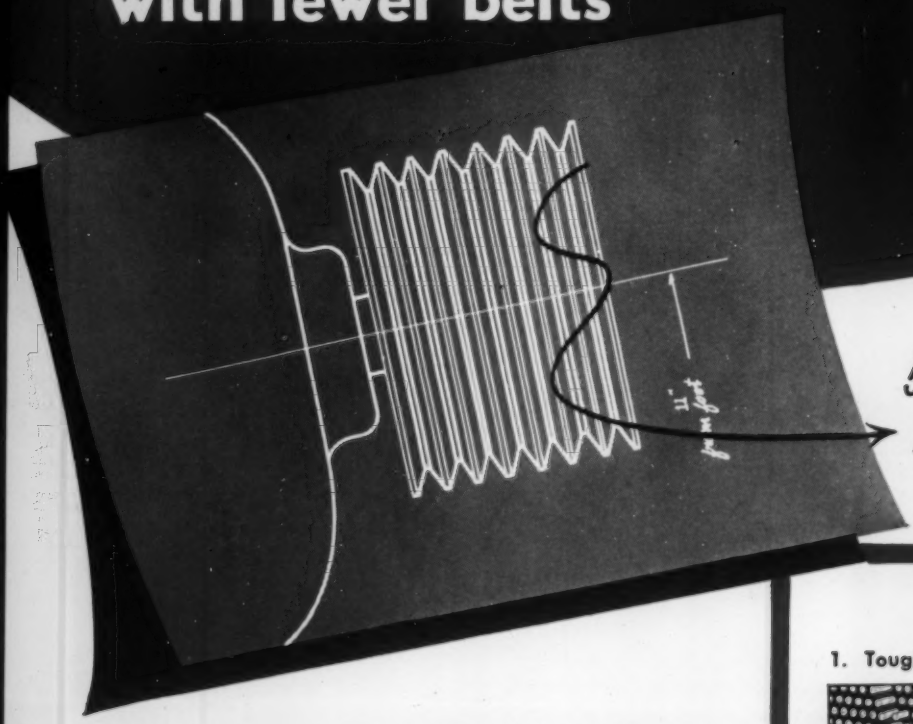
Design Engineering Show Guide

Contents, Page 3

HEYWORTH

Cut sheave width and weight...

get same horsepower with fewer belts



5 Gates Super Vulco Ropes do the work of 7 standard V-belts

Where space is limited and weight a factor, design your drive with this important fact in mind:

5 Gates Super Vulco Ropes do the work of 7 standard V-belts

That's because a Gates Super Vulco Rope has 40% more horsepower capacity — delivers more horsepower per dollar invested than any standard V-belt drive. Sheaves with fewer grooves cost less... weigh less... take less room. Drive design is invariably improved.

A wealth of drive data is quickly available to you. Simply call your nearby Gates distributor for a Gates V-belt specialist. Stocks carried in industrial centers around the world.

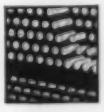
The Gates Rubber Company
Denver, Colorado

Gates Distributors are in the Yellow Pages

Gates

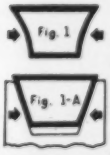
No other V-Belt has ALL these advantages

1. **Tough, resilient Tensile Cords**



Super strong resilient tensile cords provide 40% greater horsepower capacity . . . easily absorb heavy shock loads . . . reduce number of belts required . . . save weight and space.

2. **Concave Sidewalls (U.S. Pat. 1813698)**



Concave sides (Fig. 1) increase belt life. As belt bends, concave sidewalls become straight, making uniform contact with sheave groove (Fig. 1-A). Uniform contact means less wear on sides of belt . . . far longer belt life.

3. **Flex-Weave Cover (U.S. Pat. 2519590)**

A Gates exclusive: provides greater flexibility with far less stress on fabric. Cover wears longer . . . increases belt life . . . more power available to driven machine.

4. **High Electrical Conductivity**

Built into Gates Super Vulco Ropes for safer drives (in explosive atmospheres).

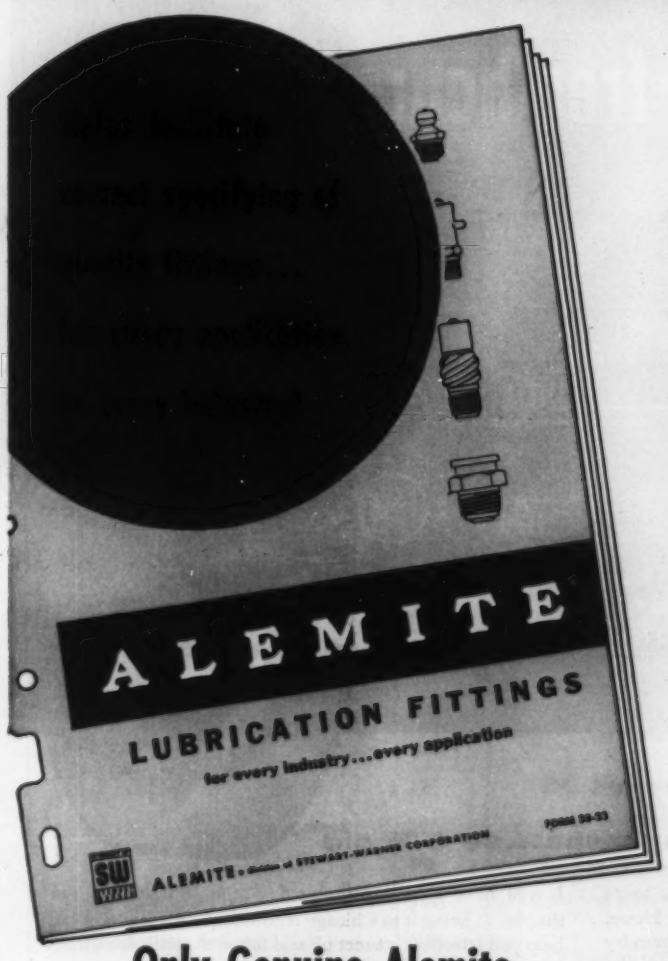
5. **Oil, Heat, Weather Resistant**

Special rubber compounds make Super Vulco Ropes highly resistant to heat, oil, and prolonged exposure to weather.

TPA 248A

Gates Super VULCO ROPE Drives

FREE! New Full-Line Catalog of
ALEMITE Lubrication Fittings!



Here is Alemite's new free catalog of the most *complete* line of fittings on the market! A simple, handy guide to fast, easy selection of the right fitting for every requirement. Contains detailed drawings of all Alemite fittings including the famous Alemite "Red-Ball" Hydraulic Fittings. Also lists many types of fittings that have been developed for special purposes—including relief fittings, measuring fittings and drive fittings. Complete with individual dimensions—ready for transfer to your own blueprints. Fill out the coupon below. Send for your new full-line catalog of Alemite Fittings today!

Only Genuine Alemite Red-Ball Fittings Offer These Four EXTRA Advantages!

1. Flat top with clean, dirt-cutting edge bites through dirt and old grease instantly!
2. Made *armor-hard* to resist nicks, scratches, distortion!
3. Tip has rounded contour to give extra working angle. No ridges . . . coupler won't slip off in tight quarters!
4. Extra-thick wall gives unequalled strength—withstands hard field service!

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Division of STEWART-WARNER CORPORATION

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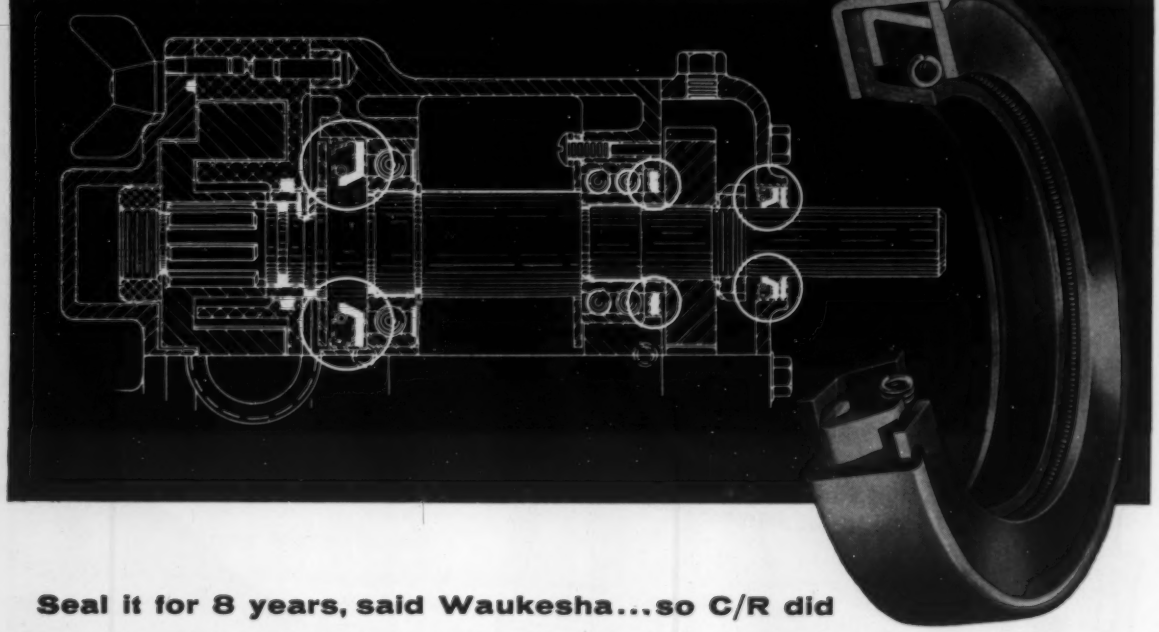

Seal it for 8 years, said Waukesha...so C/R did

"And, we might add, we have had very, very few instances of failure with C/R Oil Seals," says Mr. Emil M. Howe, Vice President, Pump Division of the Waukesha Foundry Co. Long service life is only one of the requirements met by the C/R Types P, G and A Oil Seals in this Waukesha Sanitary Pump. They must seal effectively eight hours a day, six days a week for eight years . . . at shaft speeds up to 750 r.p.m., with pump head pressures up to 150 p.s.i., and temperatures ranging from 0° to 220° F., depending on the food material pumped. They also must resist food acids, and the acids and alkalies in the commercial detergents used to cleanse and flush the pump daily. An added indication of C/R Oil Seal dependability in the Waukesha Sanitary Pump is the fact that it constantly must meet rigid 3-A Sanitary Standards for the Dairy and Food Industries.

If you have a sealing problem . . . equally critical . . . or simple . . . bring it to Chicago Rawhide. C/R engineers will help you select the correct oil seal for your application from stock . . . or cooperate with you on special designs.

See us at the Design Engineering Show, Booth 616-618

CHICAGO RAWHIDE MANUFACTURING COMPANY
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Offices in 55 principal cities. See your telephone book.

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Export Sales: Geon International Corp., Great Neck, New York.

OIL SEAL C/R DIVISION
CHICAGO RAWHIDE

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Sirvene (synthetic rubber) molded pliable parts • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears

MAY 16, 1957
Volume 29—No. 10
THE PROFESSIONAL JOURNAL FOR ENGINEERS AND DESIGNERS

MACHINE DESIGN

Engineering News Roundup 5
High-temperature aircraft bolts—new code for engineer recruiting—automatic welder with electronic positioning—high-speed teletype—error-directed automatic pilot.

The Show Goes On 109
Editorial—COLIN CARMICHAEL

Scanning the Field for Ideas .. 115
Tubular screw design—separate load connections for multivoltage circuit operation—galaxy of balls as power transmitting element—single-lever drive control.

Design in Action 135
Variable-speed control featured in home movie projector—handle-antenna integrated into portable radio cabinet—neoprene bellows drives rotor pitch-control mechanism—radar controls airborne searchlight.

Tips and Techniques
Drawing radial lines, 130; Improving compass, 143; remembering stress formula, 150.

Index (classified by subject) ... 17

Reader Service Cards 19

Meetings and Expositions 36

Helpful Literature 190

New Parts and Materials 204

Engineering Dept. Equipment 297

Stress Relief 308

The Engineer's Library 314

Noteworthy Patents 320

Advertising Index 345

Business Staff 345

EDITORIAL OFFICES

Penton Building, Cleveland 13, O.

Branch offices: New York, Detroit, Chicago, Pittsburgh, Washington and London

Man-Machine Systems 110
RICHARD COBURN—Principles of control-display arrangement and panel layout for accurate communication between machines and their operators.

Giant Linkages 118
R. S. HARTENBERG—A look at some outstanding early mechanism designs.

Subfractional-Horsepower Motors 120
MORRIS ROTHENBERG—A review of factors affecting selection and application of extremely small-size ac motors.

Hot Extrusion and Cold Drawing 127
R. L. HUGO—Basic considerations in the design of intricate steel shapes for production by a combination extruding and drawing process.

Hydraulic Actuating Systems 131
B. SAELMAN—How to design for minimum weight and high efficiency.

Bearing Misalignment 140
AUGUSTINE J. SCALZO—Theory and application of a method for evaluating stress-modifying moments caused by one or more misaligned bearings.

Nonlinear Springs 144
FRANK A. VOTTA, JR.—Design and application characteristics of spring forms which provide varying gradient over their operating range.

Moments of Inertia 147
RICARDO CHICUREL—*Data Sheet*—Graphical method simplifies design calculations for components with irregular or nonsymmetrical outlines.

DC Power Sources 151
E. J. LAUGHLIN—Design Abstract.

Exploiting Inventions 153
WALTER C. MIDDLETON—Design Abstract.

Pressurized Metallic Seals 154
GEORGE R. KELLER and PARIS H. STAFFORD—Design Abstract.

DESIGN ENGINEERING SHOW GUIDE ... 157
Complete details of the forthcoming Second Design Engineering Show and Conference presented in handy guide-book form: New ideas from the show, conference program and speakers, where to go, what to look for.

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MACHINE DESIGN is sent at no cost to management, design and engineering personnel whose work involves design engineering of machines, appliances, electrical and mechanical equipment, in U. S. and Canadian companies employing 20 or more people. Copies are sent on the basis of one for each group of four or five readers. Consulting and industrial engineering firms, research institutions and U.S. government installations performing design engineering are also eligible.

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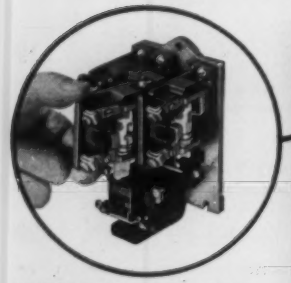
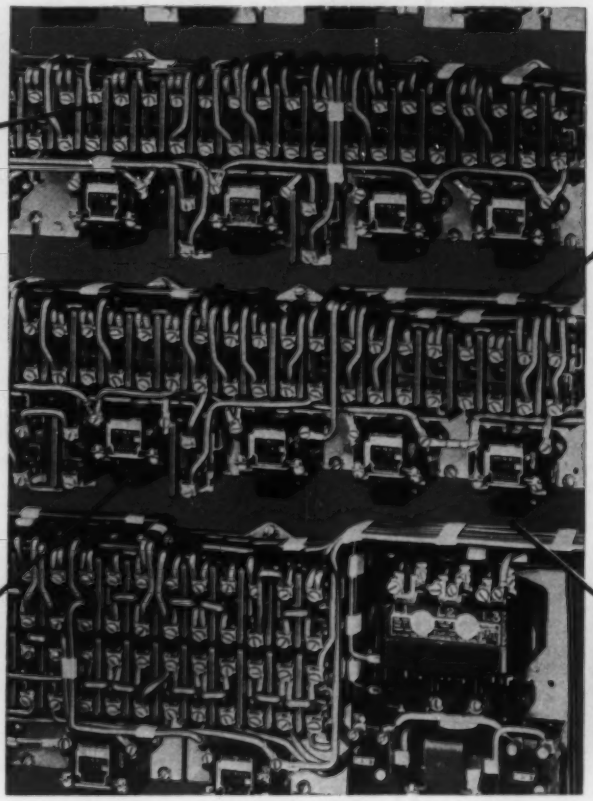
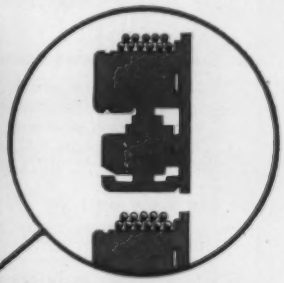
Why CLARK Type "PM" RELAYS give you more contacts per square foot of panel space!

Unique Features Produce Rugged Yet Compact Heavy-Duty Relay...

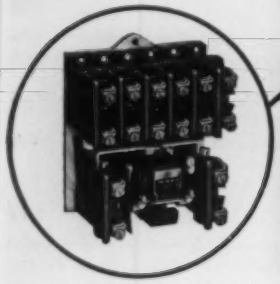


SECTIONAL POLE CONSTRUCTION. A Clark exclusive . . . With each pole in its individual melamine chamber, space between relays for electrical clearance is unnecessary. Front-mounted terminals eliminate need for extra side clearance. Sides of contact blocks are flush with edges of mounting plate.



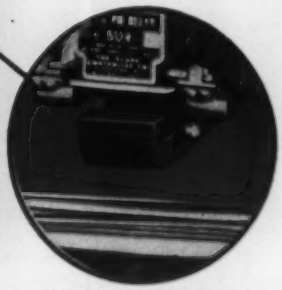


BUILT-IN WIRING SHELF . . . The melamine tops of the pole assemblies provide an insulating shelf free of current-carrying parts. Wiring can be bundled or laid flat right on top of the relay, saving additional space between rows. When wiring troughs are desired, they can be placed much closer to the top of the relay. This feature is another Clark exclusive.

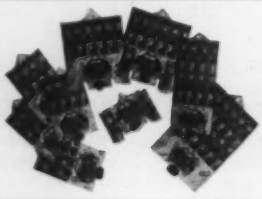


EIGHT-POLE SINGLE DECK . . . Only Clark makes it possible to have an eight-pole relay with single-deck wiring. At the same time, it uses every square inch of space on mounting plate, and lines up perfectly with Clark 2, 3, 4 and 6-pole single deck relays.

UNIFORM DIMENSIONS . . . Clark type "PM" relays are an integrated line designed so that they can be mounted side by side in perfect alignment with each other. In addition, the double-deck models have identical mounting dimensions with Clark type "CY", size 1 starters. Result: Neater, more uniform and more compact control panels.



⅞" MAGNET CLEARANCE . . . That's all the space needed to remove magnet and change coil. In overall panel construction and layout, this feature saves space by reducing amount of space between rows.



FREE TEMPLATES!

FREE TEMPLATES! Write for kit of actual-size photo-templates of type "PM" relays mounted on heavy cardboard. A great time-saver in laying out control panels. Each template has detailed dimension drawing and pole arrangement on the back.

The **CLARK** **CONTROLLER** *Company*

Everything Under Control

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IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

Circle 406 on page 19

Engineering News Roundup

Fast-Talking Machine Equals Output Of 30 Typists

Phone Line Tie-Up Kept To Minimum

NEW YORK, N.Y. — Automatic transmission of data at 1000 words per minute—16 times faster than conventional teletype systems—was announced recently by Bell Telephone Laboratories. Typewriter-size models of the subset machine perform functions of memory, logic, oscillation, modulation, and amplification by solid-state electronics. No vacuum tubes are used.

For a given amount of information, the machine reduces the amount of telephone line time needed for transmission. During off-peak telephone traffic hours between 5 p.m. and 9 a.m., subset output over one line is equivalent to that of 30 expert typists typing at full speed for 8 hr. The subset is designed to operate in connection with a variety of information processing machines. Error-checking equipment added to receivers will reject portions of transmissions affected by disturbances, and cause them to be retransmitted. Voice communication precedes or follows the operation.

Numbers, letters, or symbols are placed on magnetic tape in groups of seven by a computer, typewriter, or other machine. These characters, in the form of spots, are magnetized to represent either zero or one. All information is translated into a code using combinations of the two numbers. The message is sent by a subset machine to a receiver which picks it up in tape form for decoding. Electric typewriter mechanisms could be set to type out the messages automatically from the tape at a faster rate than a typist could attain. Most present-day business machines could be modified to process the magnetic tape.

ANY FIRE, ANYWHERE, will be fought with this new military fire truck built for the Army Corps of Engineers by Walter Motor Truck Co. In extreme heat or cold, over soft ground and cross-country, it carries a crew of six, 1000 gallons of water and 150 gallons of foam concentrate. A centrifugal pump rated 1500 gpm and foam proportioner discharge the mixture through a roof turret controlled electrically from within the cab. Integrated body and frame are aluminum, insulated, and ride on four 16:00-25 tires. Rear-mounted 330-hp engine drives all wheels through torque converter. Three-speed transmission enables road speeds to 60 mph. The truck is 28 ft long; has 186-in. wheelbase; weighs 36,000 lb, loaded.

Special feature in this issue of MACHINE DESIGN is a useful guide to the 1957 Design Engineering Show and Conference. Starting on page 157, the guide includes the program for the Conference, new products at the Show described in text and pictures, a list of all Show exhibitors with booth numbers and products exhibited, and the floor plan of the Coliseum. In this issue's editorial, MACHINE DESIGN'S editor, Colin Carmichael, states his case for these events.

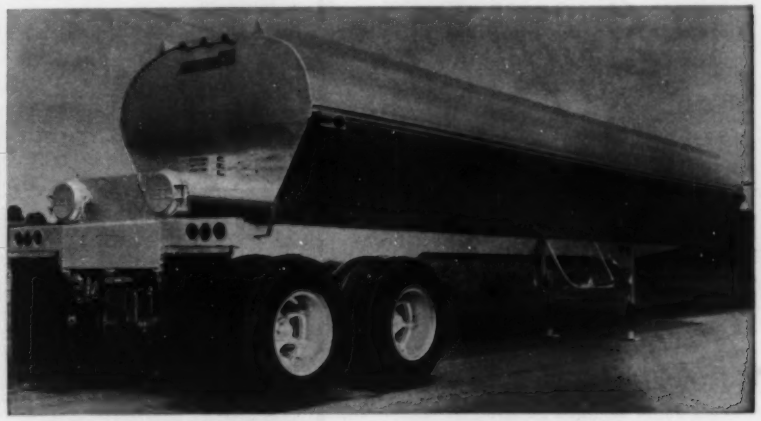
Energetic Film Splicer Fuses Mylar-Type Film

SUMMIT, N.J.—Dielectric heat is used to splice new Mylar-type film in a new film splicer announced recently by Shepard Laboratories, Inc.

The Shepard Electronic Film Splicer fuses film by applying intense, high frequency energy to overlapped ends of the splice. Fusing takes place so rapidly that original molecular orientation of the film is not disturbed. High strength and durability of the film are retained. Because of a sud-

den energy reduction at the instant of fusing, there is no danger of film burning. The splicer can be used on standard acetate films.

DIFFICULT EXTRUSION IN STAINLESS STEEL was made recently by Allegheny Ludlum Steel Corp. The extrusion, of Type 410 stainless steel, was made in 12-ft lengths on production equipment, at production speeds and temperatures. The die was designed with a ratio of cross sectional area to perimeter of 10 to 1.



FRAMELESS DRY-BULK CARRIER has been redesigned to make the body support the load as well as contain the cargo. Consequent reduction of frame also reduced overall weight. The trailer is made by Highway Trailer Co. for transport of loose bulk cargo such as cement, lime and grain. In section, body floor is W-shaped. Two screw conveyors in the W-troughs are driven by 25-hp engine in trailer-front compartment; unload cargo to the rear at 7 barrels per minute regardless of trailer position. Conveyor-motor clutch controls and discharge port controls are located at rear-curbside.

Form North American Control Systems Council

NEW YORK, N.Y.—A joint council of the American technical societies which conduct engineering and scientific activities in control systems engineering was formed recently in Chicago at the Western Society of Engineers. Delegates were representatives of the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Institute of Radio Engineers, Instrument Society of America, and American Institute of Chemical Engineers. Two initial objectives were framed:

1. Co-operation in the organization and operation of a proposed international federation of control systems engineering.

2. Co-ordination of the professional activities, meetings, conferences, symposia, and joint control meetings of American technical societies.

Dr. Rufus Oldenburger, chairman of the Instruments and Regulators Division of ASME will represent the newly formed council at a meeting in Dusseldorf, Germany. Final plans will be made for the first formal meeting of the proposed international federation of control.

Transistor Use In TV, Radar Seen Possible

High Frequency Transistors Now In Commercial Production

SYRACUSE, N.Y.—Transistor use in TV sets, two-way radios and radar is now possible with new high frequency germanium tetrodes developed by GE. The three transistors with a common base connection and bandwidth of 2 megacycles are rated for a minimum 10-db gain at 15, 30, and 120 megacycles.

Ordinary pencil eraser dwarfs high-frequency transistor designed to amplify a 120-megacycle signal.

High frequency performance is attributed to GE's meltback process which produces p-type germanium layers used in the transistors. Twenty such layers are required to equal the thickness of a single magazine page. Connections to each layer are made with a wire one-quarter the size of a human hair.

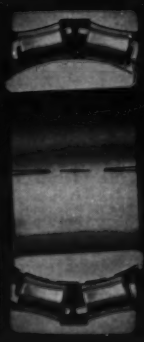
The transistors are hermetically sealed in welded cases with glass-

Front Cover

A new design for our magazine name makes its first appearance this issue —a change which we feel will further improve the appearance of Machine Design's front covers.

"Design engineering" is the key to artist George Farnsworth's cover theme. All engineers will recognize the familiar harmonic curves. Hydraulic, electrical and mechanical component symbols, plus materials cross sections, round out the cover design. Featured article is the "Design Engineering Show Guide" on Page 157.

self-aligning . . . CAN'T BIND



HOW SELF-ALIGNMENT WORKS. Spherical inner ring, free to align in any direction, assures full load capacity regardless of shaft deflection or support misalignment.

Husky bearings in husky housings adjust immediately in any direction

When high-impact loads deal out punishment, shaft deflection may spell a quick finish for ordinary bearings. But this rugged Link-Belt bearing is *self*-aligning . . . won't "pinch" or bind when misaligned.

Complete protection is provided by effective seals which block entrance of dirt, escape of lubricant. Durable housing—machined as two perfectly matched parts provides easy installation without shims or alignment rings.

Get full data on Link-Belt's complete bearing line from Book 2550. Ask any of 40 offices.

Visit our exhibit, Design Engineering Show, New York Coliseum, May 20-23

Series 6800, 6900, 7800, 7900 roller bearings have internationally standardized boundary dimensions.

LINK-BELT

self-aligning ball and roller bearings

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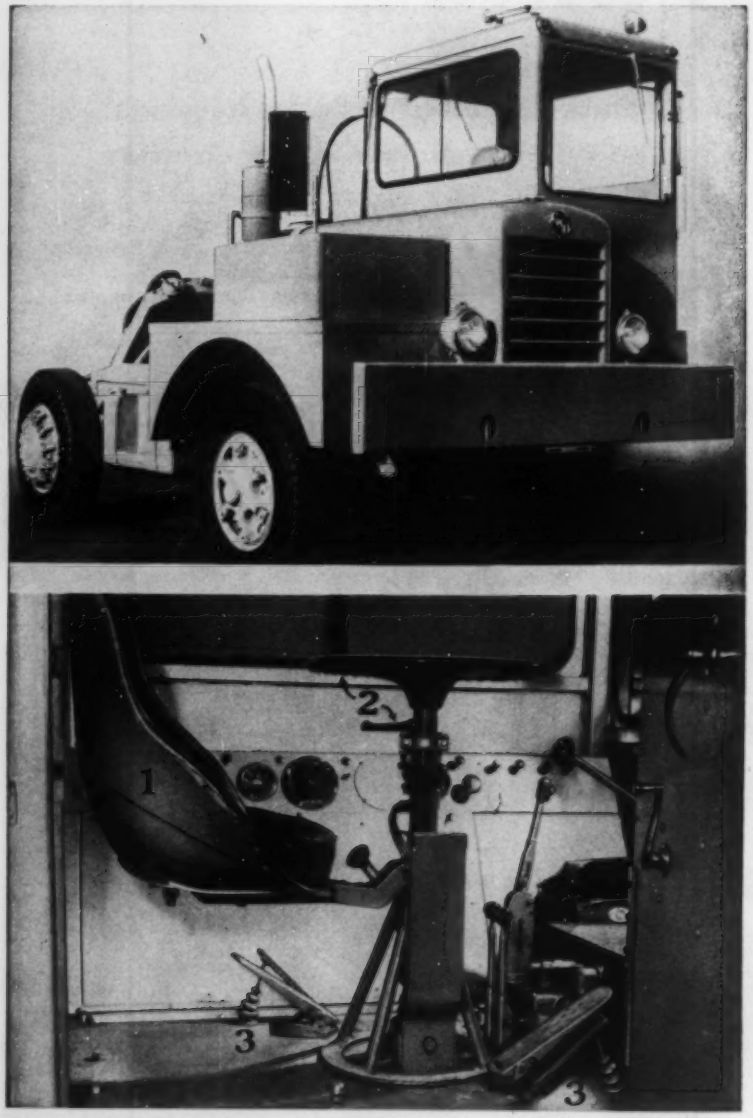
to-metal seals. The package is designed for use on printed wiring boards. The transistors can withstand shock loads which ordinarily would render vacuum tubes inoperative.



Trailer Spotter (top) by Four Wheel Drive Auto Co. can go equally fast forward and backward. Its cab (bottom) has: (1) swivel seat which turns about the steering column so driver can face the direction of movement; (2) steering wheel for front wheels and steering lever for rear wheels; and (3) two sets of accelerator and air brake pedals.

Sturdy, Versatile Mover To Step Up Trailer Shuttling

Swinging 'Round His Wheel, Driver Always Faces Forward

CLINTONVILLE, WIS. — Short distance shuttling of highway trailers should be simplified and speeded with a new vehicle called Trailer Spotter recently introduced by Four Wheel Drive Auto Co. The Trailer-Spotter is intended for service in truck terminals, at rail-freight terminals, and on docks.

Trailer Spotter can go as fast

Topics

Atomic - powered plane should be ready for flight by the mid-1960's. The problem of weight, a primary concern of the plane's designers, is now receiving attention. The Air Force is seeking a more compact engine with lighter shielding.

• • •

Sixty-mile missile is to be developed by the Navy to collect weather data. This altitude would be three times that reached by the HASP (High Altitude Sounding Projectile) weather rocket which was tested recently. Rockets are to be launched at sea; wind and weather data recording instruments will be released and float down under balloons.

• • •

No need to wind the clock—or to see that it's plugged into an outlet—thanks to the inventors of a new GE wireless electric model. This clock is powered by batteries and has a receiver to catch the 60-cycle impulses emanating from alternating current in home or office wiring.

• • •

Pushbutton-operated gavel calls a meeting to order automatically and easily. A built-in "mood selector" provides a selection of volume and tempo, offering the gavel-wielder a choice of Tired. Normal, Mad, Drop-Dead or Apoplectic. The device was developed by Dave Choate, of Minneapolis-Honeywell, and bequeathed by him to Lloyd Combs, of Du Pont, upon the latter's succession to the presidency of the Wilmington section of the Instrument Society of America.

• • •

Mit der engine in der tail, a new German plane can attain cruising speed of about 115 mph. The aircraft has a 65-hp Porsche engine. It is used as a training plane.

• • •

Largest molded shape ever produced from linear type, high tensile strength polyethylene is the claim for a 10 by 12 by 9-in., 40-lb block of the material molded by American Agile Corp. This material is used to replace lead for shielding in atomic reactors because of its lighter weight.

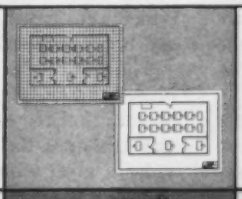
FROM BRUNING—YOUR ONE CONVENIENT SOURCE FOR ALL DRAFTING NEEDS...

7 WONDERFUL TIME-AND WORK SAVERS!

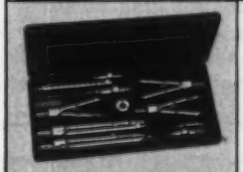
Bruning Electric Erasing Machine, shown at left, saves hours of finger-cramping manual erasing, lets you do a neater, safer erasing job. Extra-long, 7-inch eraser.

The *right* tool or material for the job, whether it's a large or small item, means a lot in drafting! That's why the outstanding drafting aids featured here are important to you. That's why they are important members of Bruning's complete quality line. Try them; you will be mighty pleased at how fast the savings of time and labor mount up.

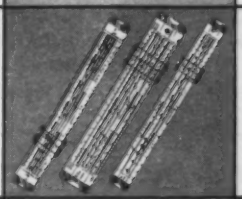
"Visi-Vel" Tracing Paper
This wonderful new resin-transparentized tracing paper offers up to 25% faster reproduction speed, unsurpassed toughness, durability, and permanence. Accepts pencils as hard as 9H, and areas can be erased repeatedly without damage to drawing qualities. Rolls or sheets. Thin, medium, heavy weights.



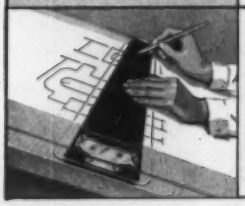
"Grid-X" Tracing Paper
The cross section lines eliminate time-consuming measurements, speed and improve lettering. They do not reproduce, so prints show only lines you draw. "Grid-X" saves time and work on scale drawings of irregular shapes, sketches, plant layouts . . . in fact, on almost any drawing. Pads, sheets, and rolls.



Wild Stainless Steel Instruments
Now, get the higher precision, lifetime durability and beauty offered only by the instruments made entirely of stainless steel. They will not oxidize, cannot be damaged by perspiration. Specially hardened swivel-type pen nibs are easy to clean, will remain sharp. Swiss precision-made. Moderately priced.



"Eye-Saver" Slide Rule
The green-yellow color of this all-metal rule provides easier, more accurate reading. It prevents reflected glare, brings scales into sharp, true focus, provides optimum contrast with scale graduations. Rule can not be damaged by moisture and severe wear and tear, is unaffected by temperature changes.



"Mobile" Parallel Straightedge
It rolls freely and smoothly over your drawing on retractile rollers located on the underside of the blade—lets you make neater drawings, faster and easier! Rollers retract under slight pressure, won't damage or mark your drawing. Easy rolling action permits fingertip positioning of the edge.

Wrico "Zephyr" Lettering Set
Now, get the work-saving advantages of a modern scriber-type lettering set . . . for less than ten dollars! Unique skid-proof runners keep the guide holder securely in position for perfect lettering. Three popular sizes of letters and numbers provide a versatile lettering combination.

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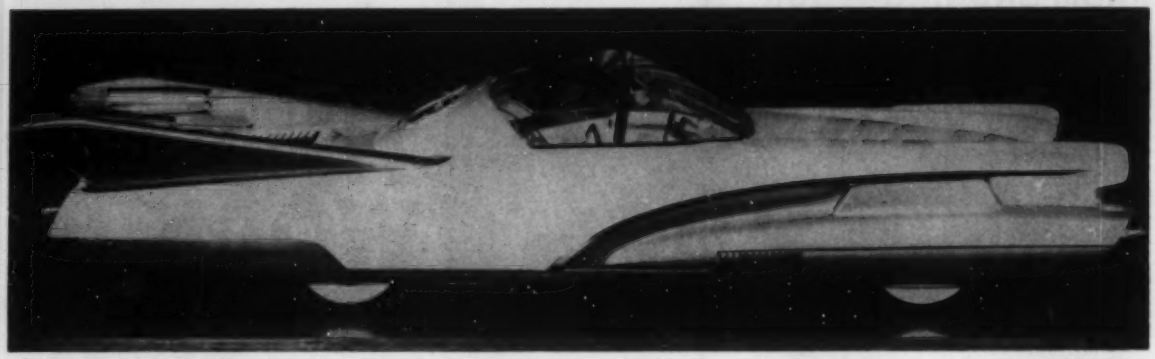


FLOATING FINS AND SUSPENDED FENDERS mark Ford's experimental X-1000 model. Not exactly a dream car, says Ford, because some of its features will appear in production cars to come. The X-1000 canopy retracts to make the car a convertible. Any of several new type engines, at front or rear, can be the power. Front fenders carry oil coolers, and an aftercooler is mounted on the rear deck lid. The instrument panel and transmission pushbuttons "float" inside a deep-dish steering wheel. The car seats three.

backward as forward, and can hook onto, move, and unhook from a trailer without the driver getting down from his cab.

The driver always sits facing the direction of movement. His seat swivels around a vertical steering column in the center of the cab. He steers either the front wheels, the rear wheels, or both sets simultaneously.

The Trailer Spotter has three speeds in each direction with a top speed of 27 mph, pulling or pushing a fully-loaded trailer. Its short wheelbase of 106 in. assures good maneuverability.

Engagement and disengagement of trailers are facilitated by two special features. They are a hydraulic elevating fifth wheel, which raises the trailer sufficiently to eliminate hand-cranking of dolly wheels, and a rear cab door, which opens onto a small platform from which the driver can make trailer air hose connections.

The cab of the Trailer Spotter is offset to the left of the engine to permit the driver to see alongside the trailer. Extensive glass provides a good view in all directions.

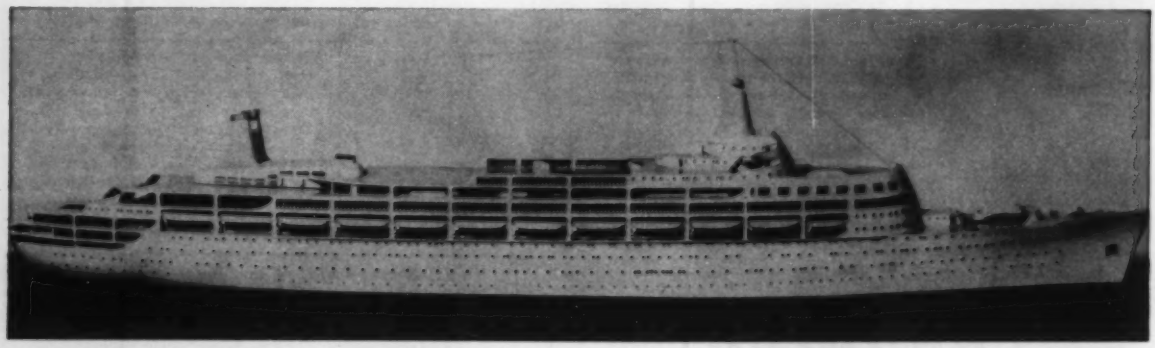
The Trailer Spotter has a 165-hp engine which transmits power to the axle beneath the fifth wheel. Four wheel drive is optional.

Engineer Recruiting Practices Prompt New Code of Ethics

Placement Activities Need Businesslike Touch

URBANA, ILL.—A code of ethics for engineer recruiting is being prepared jointly by the American Society for Engineering Education and the Midwest College Placement Association. The new code suggests prompt, businesslike placement activities because of the great demand for graduates.

Excesses in recruiting practices should be avoided. The code discourages elaborate entertainment.



LOW DOWN LIFEBOATS will distinguish this new liner—biggest since the *Queen Elizabeth*—planned by Peninsula and Oriental Steam Navigation Co. The lifeboats will be three decks below the usual boat deck and flush with ship's sides. Lower stowage will improve weight distribution; make boat launching safer. Other unusual features will be an engine room aft below twin funnels, lightweight superstructure made of 800 tons of aluminum, and an 85,000-hp turboelectric power plant. The new ship, not yet named, will be 814 ft long, 104 ft wide, have 31½-ft draft. It will carry 600 first-class and 1650 tourist passengers between the United Kingdom, Australia, and the U.S.-Canadian west coast. It will travel at 27½ knots.

FACTS

about

NEW DEPARTURE BALL BEARINGS

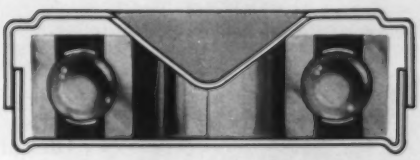
Transparent box permits quick visual inspection of contents. Box sealed with oil-resistant tape—can be resealed after opening. Bearing identification clearly marked on outside of box. Bearings kept free of contaminants right to assembly area.

PROTECTION FOR PRECISION

No precision machine is better than the bearings that support its rotating parts. That is why you find so many highly accurate machines employing New Departure precision ball bearings of ABEC 5, 7 and New Departure 9 specifications.

But, to be sure that all the fine performance of which these bearings are capable is fully obtained in the machine, such bearings must be protected from dirt, needless handling and exposure before mounting.

Now New Departure gives you such *protection* for *precision* in another "new departure"—a sealed, transparent container with the important advantages described at the right. Available for a wide range of ABEC 5, 7 and ND 9 specification bearings.



Inverted cone in cover holds bearing in central position—permits packaging several sizes of bearings in one box size.

Easy to stack and stock. Box tops and bottoms mate for quick, non-sliding stacking—with identification markings visible for each box.

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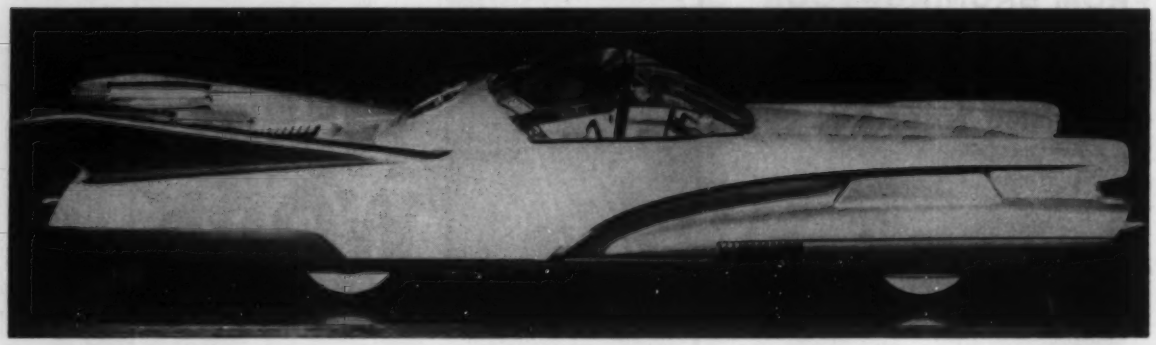
DESIGN ENGINEERING SHOW
NEW YORK CITY COLISEUM, MAY 20-23

SEE "WIDE WIDE WORLD" SUNDAYS—NBC-TV

BALL BEARINGS MAKE GOOD PRODUCTS BETTER

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONN.



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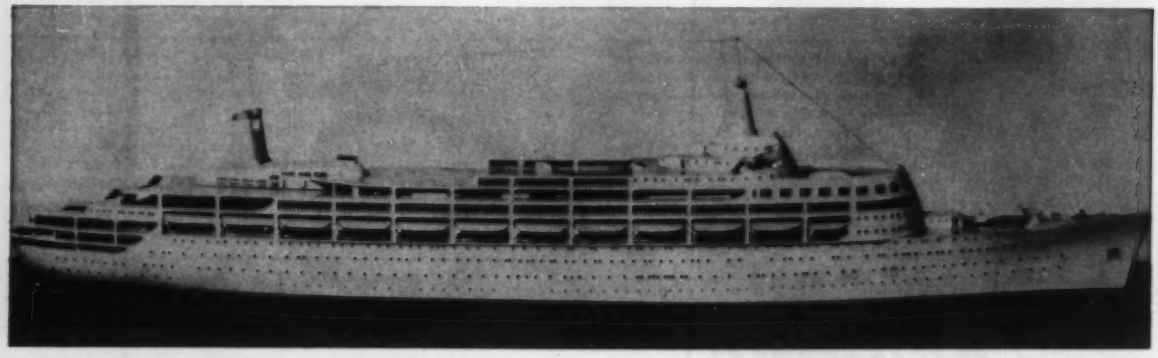

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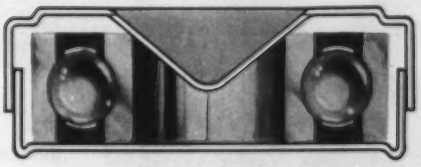

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overselling, special payments and bonuses, and rewards to third parties who have persuaded students to accept employment offers. A student should not hoard or collect job offers. When he accepts an offer, he should inform other prospective employers of his decision. All-expense interview trips should be avoided unless the student is sincerely interested in the company.

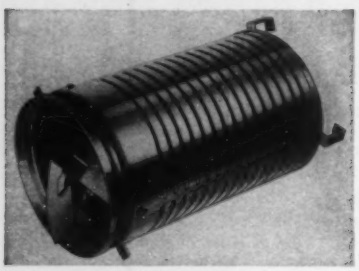
Colleges are urged to help by discouraging indiscriminate shopping, encouraging a businesslike procedure for both student and interviewer, and by competent advertising which is not unduly influencing.

Copies of the new code of ethics are available from the Secretary of the American Society for Engineering Education, University of Illinois.

Power Absorber Is Compact, Lightweight

CHICAGO, ILL.—A small, cylindrical power absorber which replaces a bank of twenty-seven 500-w stick resistors has been announced by the Sun Electric Corp.

The Power Absorber operates at 13,500 w continuous duty, and

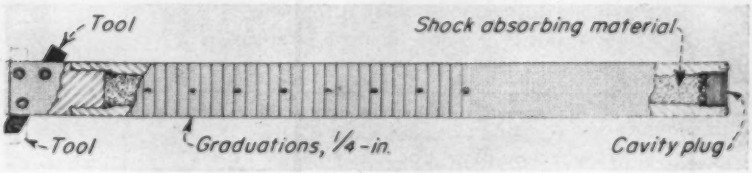


New Power Absorber replaces 27 stick resistors; takes 1/25 the space.

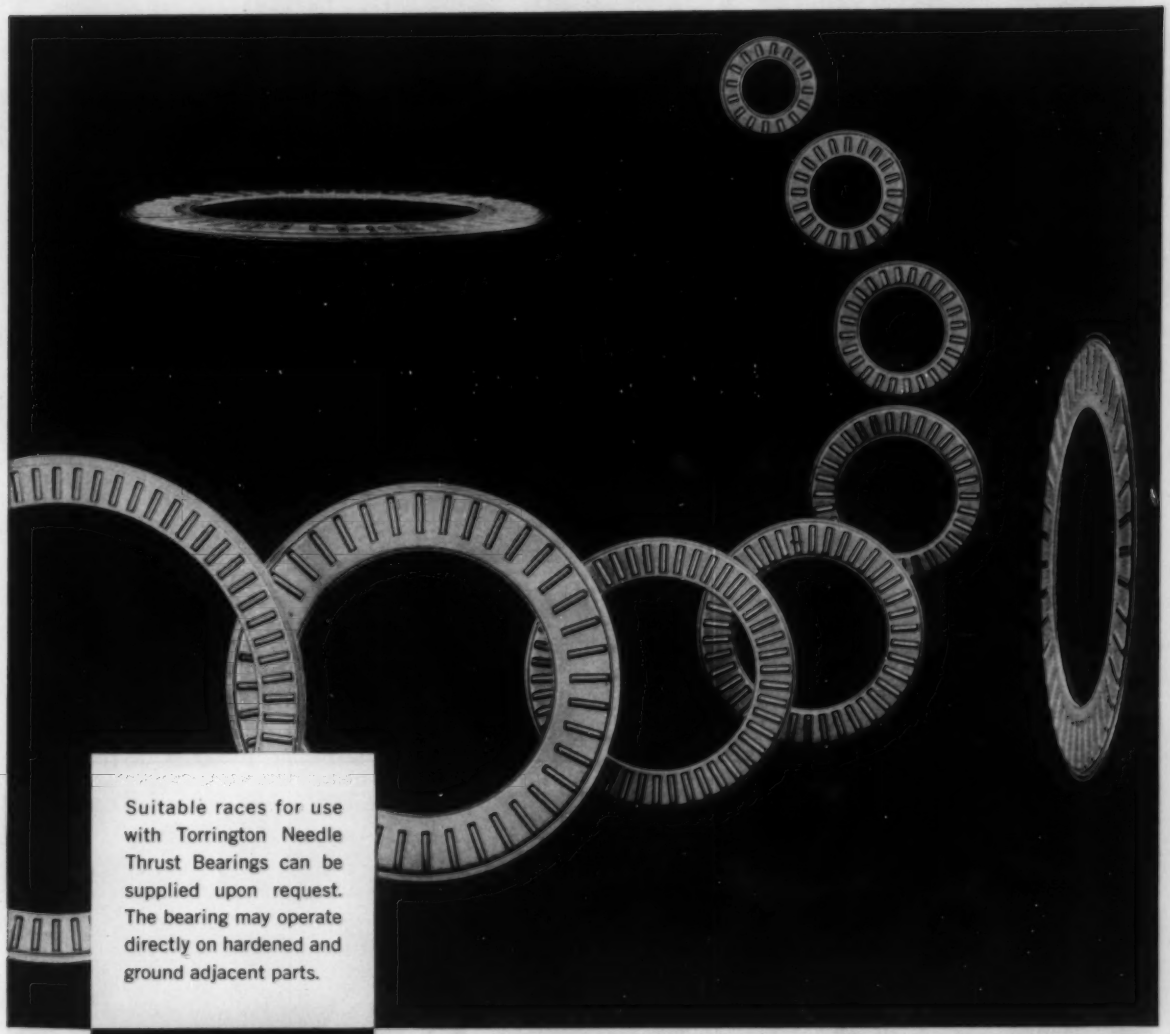
weighs 1 lb per kw absorbed. Motor and fan can be operated as part of the load, or from an independent power source. Air is drawn in through slots in the casing and circulated over V-section resistors.

Adaptations of the Power Absorber are in use in the Redstone and Snark missile systems.

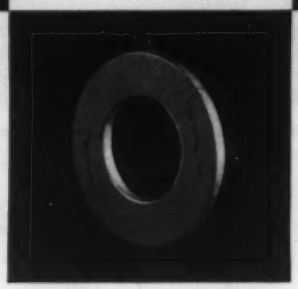
TILTING-WING FLYING MACHINE, developed by Vertol Aircraft Corp. for the Army, has been brought to test stage less than a year after design was started. Designated Vertol 76, the plane is powered by a Lycoming T-53 gas turbine mounted aft the crew enclosure. The wing and two counter-rotating propellers tilt up for vertical take-off and landing; turn horizontal for conventional travel. Two ducted fans in the tail control yaw and pitch in hovering flight. Short take-offs and landings, as well as vertical, are planned for the new craft. The wing may be rotated to any angle depending on runway length and weight of cargo.



BIGGER, SMOOTHER CUTS can now be made with this centerless boring bar, according to its maker, Pensco Products. From both ends, the inside of the bar is bored to various sizes to minimize harmonic vibration. Inside diameters were determined by using a vibration meter and probing bar at quarter-inch intervals. Bar core is filled with shock-absorbing material. Quarter-inch graduations shown indicate penetration into the work.



Suitable races for use with Torrington Needle Thrust Bearings can be supplied upon request. The bearing may operate directly on hardened and ground adjacent parts.



Torrington's new Needle Thrust Bearing grows in popularity... and range of sizes

Designers have been quick to take advantage of the compactness, high thrust capacity and low unit cost of Torrington's new Needle Thrust Bearing.

To meet the growing demand for this bearing in automatic transmissions, governors, steering gears, bevel gears, hydraulic pumps, torque converters and many other applications, tooling has been completed to produce bearings ranging from .500" ID to 3.000" ID.

Only .0781" thick, the Torrington Needle Thrust Bearing is thin as an ordinary thrust washer, yet brings all the advantages of anti-friction operation to applications where space is limited. Mating steel retainer halves are joined securely to form a self-contained unit that is easy to handle and install.

Plan today to evaluate the Torrington Needle Thrust Bearing. Services of our Engineering Department are available to help you. For full information, write for Bulletin No. 16, "Torrington Needle Thrust Bearings." *The Torrington Company*, Torrington, Conn.—and South Bend 21, Ind.

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Circle 410 on page 19

FULL-BLOWN AIRPLANE, MODEL 2, is this craft called Inflatoplane, recently completed by Goodyear Aircraft Corp. for the Office of Naval Research. The plane's bulky members are inflated to their final shapes. Inflatoplane's wing, tail assembly and cockpit are made of Airmat—two walls of rubberized fabric connected by nylon threads. Cigar-shaped fuselage is made of simpler rubberized fabric. A 44-hp engine powers the plane. Successor to a similar plane blown and flown last year, Inflatoplane features enclosed cockpit, one-piece wing and simplified controls. It was built to test its fabric as structural material.

French Renault Dauphine features interior and exterior restyling. Sliding roof panel is optional.

Borg-Warner synchromesh transmission is standard equipment on the Renault model 750.

French Economy Car Seeks Larger U.S. Market

Renault Dauphine
New From Road Up

NEW YORK, N.Y.—Recent production of the 100,000th Renault Dauphine on the first anniversary of its introduction was without precedent in European car manufacturing. U. S. sales of the Dauphine for the first 2½ months of 1957 exceeded total sales of all Renault cars for the previous year.

Slightly longer and 250 lb heavier than the Renault 750, the four-door Dauphine seats five passengers comfortably. It is powered by a 32-hp Ventoux four-cylinder rear engine. High power-weight ratio and low wind resistance account for a gas consumption of 50 mpg at steady speeds under 45 mph. Top speed is 76 mph.

A pressurized radiator prevents overheating and allows the engine to develop full power at best operating temperature. Manual control of radiator blinds permits fast cold-weather warmups. Transmission is a Borg-Warner synchromesh three-speed and reverse gearbox. Wheels are independently sprung. Fenders can be detached when body work is required. Engine, gearbox and frame cross members are mounted on rubber blocks.

Interior features include twin

Engine Specifications

Model	Dauphine	Renault 750
Type	Ventoux, OHV	Ventoux, OHV
No. cyls	4	4
Bore and stroke (in.)	2.28 x 3.15	2.14 x 3.15
Displ. (cu in.)	51.56	45.75
Comp. ratio	7.25 to 1	7.25 to 1
Bhp, max	32@4250 rpm	28@4000 rpm

Size and Weight

Wheelbase (in.)	89	82.75
Length (in.)	155	143.00
Width (in.)	60	56.25
Height (in.)	57	57.75
Weight (lb)	1397	1150.00

NEEDLE THREADING, BLINDFOLDED, is claimed possible with this device by Mr. Wink, Cos Cob, Conn., who also claims a tolerance of 0.0005-in. makes it an instrument, not a gadget. In one motion, four threads at once can be drawn through the needle eye. Carrying case is also needle-and-thread caddy.

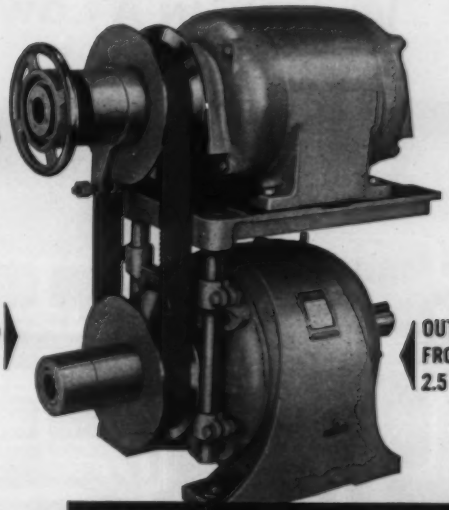
glove compartments, foam rubber seats with contoured backrests, semiflexible safety plastic steering wheel, rubber-cushioned dashboard and windshield edges, and color schemes to match body paint. Insulated engine compartment and interior are soundproofed and sealed against dust and water.

The hood of the luggage compartment opens forward. The spare wheel fits horizontally in a special compartment below the trunk and is concealed behind the license plate. Optional features include a Ferlec Automatic Clutch, sliding roof panel, radio and white sidewall tires.

The Renault 750 four-passenger sedan is powered by a 28-hp Ventoux four-cylinder rear engine. Suspension, safety features and cooling system are identical to the Dauphine. A Borg-Warner synchromesh transmission and heater are standard equipment. The optional Ferlec Clutch operated by an electromagnet, automatically disengages the engine when the rpm

(Continued on Page 22)

NEW FOOTE BROS.
Vari-Mount REDUCER



INCLUDES LEWELLEN
VARIABLE PULLEYS

- Lewellen Variable Pulleys directly connect, and variably power the drive.
- Speeds are conveniently, infinitely selective, and instantly available.
- Variable Pulleys mount compactly at shafts of standard units. Shaft bearing overhung loads are low, thrust loads are zero.
- Variable Pulleys position symetrically and positively for all pitch ratios – perform smoothly with full power at all speeds.
- Variable Pulleys provide wide selection of ratings and speed ranges, controls and accessories.

For complete specifications, ratings, dimensions – Foote Bros. Catalog JB, Lewellen Catalog 60-B.
For installing and operating Lewellen Variable Drives – new Lewellen Service Manual No. 10.
Which shall we send to you?

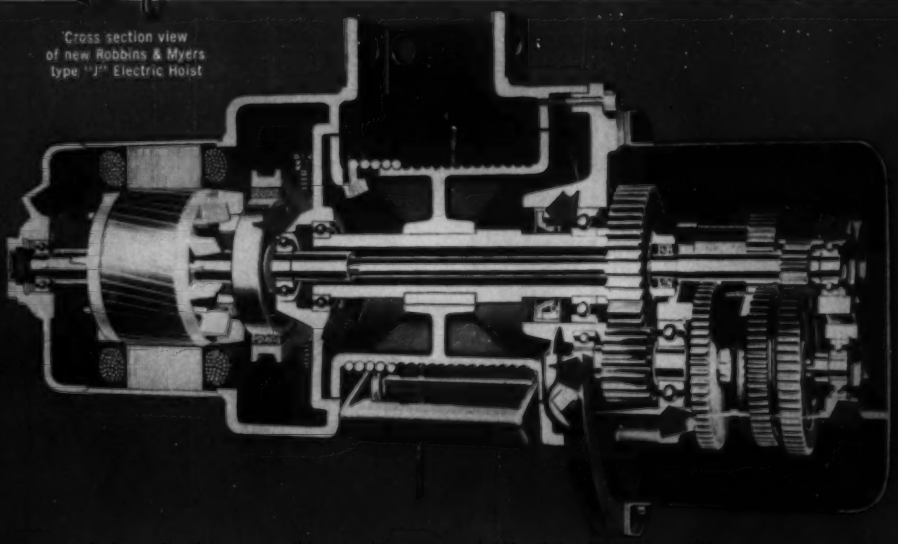
LEWELLEN MANUFACTURING CO.
COLUMBUS, IND.

Distributors in all industrial areas • In Canada – Peerless Engineering Sales Ltd. Toronto – Montreal

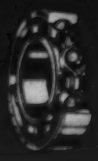
Circle 411 on page 19

9 PROVEN POINTS OF QUALITY ENGINEERING IN A LOW-COST HOIST

Cross section view of new Robbins & Myers type "J" Electric Hoist



The Fafnir 9100K Series ball bearing is designed basically for applications where housing diameters are restricted and maintenance of relatively large shaft diameters is essential. Available with seals or shields.



The Fafnir 200K Series ball bearing is well suited for applications requiring light to moderate loads combined with relatively high speeds. Available with seals, shields, and snap rings in various degrees of precision and retainer construction.

WHEN the design engineers of Robbins & Myers were asked to develop a low-cost electric hoist that would measure up to R & M standards of quality, they made good use of Fafnir Ball Bearings. They specified them to insure precise alignment of parts, conservation of power, minimum maintenance, reserve capacity for long life. In three critical locations they specified Fafnir Plya-Seal bearings — the bearings that provide superior retention of lubricant and positive protection against contaminants. With these and other construction features, they came up with the design of the new Robbins & Myers low-cost, "J" hoist, *quality engineered throughout.*

Fafnir is a supplier of ball bearings for leading industrial hoists, hoist trucks, and hundreds of other industrial machines and equipment where ball bearing advantages improve performance and prolong service life. In case after case, the choice of Fafnir Ball Bearings is influenced by the Fafnir "attitude and aptitude"—a way of looking at bearing problems from the designer's viewpoint and the ability to supply the right ball bearing to fit the need. Perhaps these attributes can help you solve a bearing problem. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR

BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

Circle 412 on page 19

MACHINE DESIGN

Reader Information Service

SUBJECT INDEX

Editorial and Advertising content classified by subject and listed by page number for convenience when studying specific design problems. For further information on subjects advertised, refer to advertisement and circle Item Number on a Yellow Card—following page.

Actuators, Edit. 131, 252, 270, 320; Adv. 231, 251, 310
Adhesives, Edit. 204, 206; Adv. 67, 268
Aluminum and alloys, Edit. 206; Adv. 330
Amplifiers, Edit. 228
Automobiles, Edit. 14
Axles, Adv. 56, 280, 286

Balls, Adv. 250
Bearing materials, Adv. 333
Bearing misalignment, Edit. 140
Bearings, ball, Edit. 236; Adv. 7, 11, 16, 21, 34, 46, 278
  miniature, Adv. 278
  needle, Adv. 13, 189
  rod-end, Adv. 60, 334
  roller, Adv. 7, 21, 34, 54, 211, 296, back cover
  sleeve, Adv. 57, 198, 330, 334
  thrust, Adv. 13
Bellows, Edit. 136
Belts, conveyor, Adv. 260
  transmission, Adv. inside front cover, 193, 211, 268, 317, 323, 331
Blowers, Edit. 292; Adv. 213, 245
Bobbins, coil, Edit. 282
Books, Edit. 314
Brakes, Edit. 232; Adv. 62, 66, 87, 335
Brass (see Copper and alloys)
Bronze (see Copper and alloys)
Brushes, commutator, Adv. 242
Bushings, Adv. 25, 36, 45

Cabinets, Adv. 290
Cables, electronic, Adv. 40
Camera, microfilming, Edit. 204
Cameras, Edit. 33
Capacitors, Edit. 270
Carbides, cemented, Adv. 286
Carbon and graphite parts, Adv. 198
Cases, aluminum, Edit. 226
Castings, Adv. 98
  centrifugal, Adv. 98, 259
  die, Adv. 48, 106, 253, 318
  investment, Adv. 22
  iron, Adv. 221, 271, 285
  nonferrous, Adv. 321
  sand, Adv. 98
  shell-molded, Adv. 98, 321
  steel, Adv. 259, 264
Chain, conveyor, Adv. 200
  transmission, Edit. 234; Adv. 83, 107, 200, 334
Circuit, etched, Edit. 208
Circuit breakers, Edit. 115, 254
Clamps, Edit. 238, 267; Adv. 51, 243, 293, 335
Classified ads, Adv. 316, 342, 343
Clutches, Edit. 204, 206, 257, 267; Adv. 90, 211, 309, 335
Coatings, protective, Edit. 211, 260
Cold heading, Adv. 218, 332
Communications equipment, Edit. 5
Compressors, Adv. 230, 276
Computer components, Edit. 208
Computers, Edit. 300
Conduit, Edit. 246
Connectors, electric, Edit. 264, 294
Contactors, Edit. 241, 287
Contacts, Edit. 224, 262; Adv. 80, 242
Control panels, Edit. 244
Control systems, electric, Adv. 41
Controls, automatic, Edit. 22, 244, 280
  cable, Adv. 338
  electric, Edit. 206; Adv. 26, 74, 80, 338
  hydraulic, Adv. 234, 334
  liquid level, Adv. 341
  mechanical, Edit. 244
  pneumatic, Edit. 230; Adv. 102, 334
Counters, Edit. 220
Couplings, shaft, Edit. 206, 211 304; Adv. 210, 232, 255, 314
Cylinders, Edit. 290
  hydraulic, Edit. 240; Adv. 70, 78, 91, 202, 249
  pneumatic, Adv. 70, 78, 91, 197, 227, 243, 249, 273

Damper, Edit. 241
Design engineering show, Edit. 157
Direct-current power sources, Edit. 151
Drafting equipment, Edit. 298, 302, 305; Adv. 9, 30, 199, 252, 298, 323, 326, 329, 333, 337, 341
Drawing, cold, Edit. 127
Drives, adjustable speed, Edit. 204, 206; Adv. 41, 104, 284, inside back cover

Electric equipment (see specific type)
Engineering, design show, Edit. 157
Engineering department (see Drafting)
Engines, Adv. 95
Extrusion, Edit. 127

Facilities, general, Adv. 288, 290
Fasteners, Adv. 218, 301
  blind, Edit. 204, 218, 285
  bolts, nuts, screws, Edit. 24, 204, 208, 276; Adv. 33, 37, 92, 196, 215, 257, 270, 278, 293, 312, 318, 319, 322, 327, 328, 332, 338, 340
  insert, Edit. 250, 287; Adv. 315, 328, 334
  locking, Edit. 204; Adv. 73, 194, 336
  pin, Adv. 308, 331, 336
  retaining rings, Adv. 293, 327, 347
  rivet, Edit. 218, 285; Adv. 291
Feeders, parts, Adv. 240, 292
Felt, Adv. 313
Fiber, Adv. 52, 103
Film splicer, Edit. 5
Filters, Edit. 242; Adv. 77, 224, 272, 329, 340
Finishes (see Coatings)
Fittings, pipe, tube and hose, Edit. 206, 218, 234, 249, 272; Adv. 72, 96, 241, 247, 299, 314, 323
Fluids, hydraulic, Adv. 85
Friction materials, Adv. 27

Gages, pressure, etc. (see Instruments)
Gaging equipment, Adv. 229
Gaskets, Adv. 36
Gear shaping, Adv. 39
Gears, Adv. 29, 86, 207, 214, 226, 228, 238, 244, 246, 256, 286
Generators, electric, Edit. 211, 232
Governors, Edit. 324
Grommets, Edit. 204

Handles, Edit. 211; Adv. 337
Hangers, cable, Adv. 51
Heat exchangers, Edit. 214
Heat-resistant alloys, Adv. 82
Heaters, Edit. 206; Adv. 28, 252, 330
Hose, metallic, Adv. 335
  nonmetallic, Edit. 234; Adv. 68, 72, 96
Hydraulic equipment (see specific type)

Indexing mechanisms, Edit. 322
Indicators, flow, Adv. 332
Induction heating, Adv. 320
Instruments, Edit. 214, 221, 240, 249, 258, 285, 297, 300, 304, 305; Adv. 218, 228
Insulation, Edit. 206, 274; Adv. 36
Inventions, exploiting, Edit. 153

Jacks, worm gear, Adv. 310

Lighting, Edit. 221; Adv. 337
Linkages, giant, Edit. 118
Lubricants, Adv. 262
Lubrication equipment, Edit. 242; Adv. 1, 224, 237, 280, 297, 339

Machines (see specific type)
Machining facilities, Adv. 318
Magnesium and alloys, Adv. 38
Man-machine systems, Edit. 110
Materials handling equipment, Edit. 8
Meetings, Edit. 38, 157
Metals (see also specific type)
Metals, Adv. 82, 321
Moments of inertia, Edit. 147
Motors, electric:
  brakemotors, Adv. inside back cover
  fractional and integral hp, Edit. 236, 232, 287; Adv. 41, 50, 87, 100, 205, 261, 265, 267, inside back cover
  gearmotors, Edit. 204, 242, 287; Adv. 41, 195, 290, 297, 323, inside back cover
  subfractional hp, Edit. 120; Adv. 94, 297
Motors, hydraulic, Adv. 61, 212
  pneumatic, Adv. 303
  torque, Adv. 251
Mountings, vibration and shock, Adv. 263, 294

Nonlinear springs, Edit. 144

MACHINE DESIGN is indexed in Industrial Arts and Engineering Index Service, both available in libraries, generally

Packings, Adv. 36, 268, 305, 341
Pitch-control mechanisms, Edit. 136
Plastics, Edit. 206; Adv. 52, 76, 103, 192, 225, 277
Pneumatic equipment (see specific type)
Powder metallurgy, Adv. 57, 88
Power absorber, Edit. 12
Projector, motion picture, Edit. 135
Pulleys (see also Sheaves), Adv. 210, 317, 323
Pumps, Adv. 201, 213, 275, 282, 328
hydraulic, Edit. 294; Adv. 61, 106, 202, 212, 236, 306
pneumatic, Adv. 276

Radio, portable, Edit. 135
Recorders, Edit. 297, 304
Rectifiers, Edit. 151
Reducers, speed, Edit. 224, 248; Adv. 97, 195, 214, 220, 238, 323
Regulators, flow, Edit. 206
pressure, Edit. 228, 238; Adv. 224
Relays, Edit. 252, 280, 326; Adv. 4, 105, 219, 258, 272, 338, 341
Research and development, Adv. 277
Resistors, Edit. 248; Adv. 217
Rubber, Adv. 277, 281, 300, 339
Rubber molding, Adv. 254

Screws, Edit. 115
power, Adv. 231
Seals, Edit. 250, 254, 278, 326; Adv. 36, 198, 326
mechanical, Edit. 154; Adv. 2, 47, 64, 233, 302
pressurized, metallic, Edit. 154
Searchlight, airborne, Edit. 138
Shafts, Adv. 56, 286
flexible, Adv. 262
Sheaves (see also Pulleys), Adv. 203, 210, 311, 317, 323
Shims, Adv. 36
Silicones, Adv. 254, 339
Slip-ring assemblies, Edit. 274
Small parts, Adv. 318
Solenoids, Adv. 235
Spindles, Adv. 31, 280
Splines, ball-bearing, Adv. 231
Springs, Edit. 144; Adv. 248
Sprockets, Adv. 46, 200, 210, 329
Stampings, Adv. 256
Starters, motor, Adv. 244
Steel, Edit. 204; Adv. 23, 58, 288, 325
stainless, Adv. 65, 71, 84, 283
Switches, Edit. 262, 272, 284; Adv. 74, 80, 298
Systems, man-machine, Edit. 110
Systems, hydraulic, Edit. 131; Adv. 99, 202, 212

Testing, Edit. 285, 297, 300; Adv. 216
Thermostats, Edit. 239, 256; Adv. 222
Timers, Edit. 276; Adv. 94, 272, 328
Tips and techniques, Edit. 130, 143, 150
Titanium and alloys, Adv. 38,312
Torque converters, Adv. 234
Transformers, Adv. 41
Transistors, Edit. 6, 260
Transmissions, adjustable speed, Edit. 116, 117, 282, 292, 320, 322; Adv. 15, 250, 255, 274, 284, 317, 329
Tubing, Adv. 53, 191, 314

Universal joints, Edit. 324; Adv. 255, 279, 286, 295

Valves, Edit. 208, 216, 220, 246, 258, 278, 284, 290; Adv. 79, 239, 299, 330, 340
hydraulic, Adv. 61, 202, 212, 236, 324
pneumatic, Edit. 230, 264; Adv. 102, 227

Washers, Adv. 25, 57
lock, Adv. 293
Wear-resistant alloys, Adv. 45
Welding, Edit. 30; Adv. 209
Wheels, Adv. 280, 332
Wire and wire products, Adv. 260

Zinc and alloys, Adv. 108

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CIRCLE ITEM NUMBERS—Throughout the magazine, each advertisement carries an Item Number for use in requesting further information. All product descriptions, announcements and Helpful Literature items are also numbered, and for greater convenience are indexed below by Item Numbers.

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Index to New Parts & Helpful Literature

BY ITEM NUMBERS

HELPFUL LITERATURE—descriptions start on page 190

	ITEM NUMBER
Air & Hydraulic Cylinders	751
Self-Locking Nuts	752
Roll Formed Shapes	753
Dial Indicators & Gages	754
Slip Ring Assemblies	755
Fans & Blowers	756
Stainless Steel Sheet	757
Pushbuttons	758
Worm Gear Jacks	759
High Speed Motion Pictures	760
Machine Tool Limit Switches	761
Flow Control Device	762
Seamless Tubing	763
Variable Speed Drive	764
Steel Plate	765
Extruded Aluminum Shapes	766
Stainless Steel Fastenings	767
Oscilloscope	768
Fine Pitch Gears	769
Bronze Bearings & Parts	770
Colored Aluminum Strip	771
Chains & Sprockets	772
Electric Oven Control	773
Fasteners	774
Access Latches	775
Friction & Rubber Tape	776
Analog Computer	777
Liquid Chillers	778
Stainless Ball Valves	779
Bevel Gears	780
Magnetic Clutches	781
Rectilinear Recorders	782
Miniature Fasteners	783
Titanium	784
Electronic Relays	785
Power for Pumping	786
Dispersions	787
Industrial Photo Light	788
Thermostats	789
Mechanical Packings	790
V-Belting	791
Indexing Machine	792
Welded Steel Tubing	793
Propeller Fans	794
Automatic Air Filter	795
AC Magnetic Starters	796
Carbon Graphite	797
Welded Fasteners	798
Current Collectors	799
Relays	800

NEW PARTS & ENGINEERING EQUIPMENT—descriptions start on page 204

	ITEM NUMBER
Spring-Loaded Fastener	801
Variable-Speed Drive	802
Motorized Gear Reducer	803
Clinch Nuts	804
Elastomeric Adhesive	805
Bar Stock	806
Microfilming Camera	807
Over-Running Clutch	808
Nylon Strain Reliefs	809
Backstop Clutch	810
Pressure-Sensitive Adhesive	811
Miniature Coupling	812
Pushbutton Unit	813
Controller	814
Variable-Speed Drive	815
Vinyl Sheeting	816
Expansible Compounds	817
Color-Anodized Aluminum	818
Expansion Joint	819
High-Temperature Insulation	820
Electrical Heating Elements	821
Anchor Nut	822
Transistorized Circuits	823
Flow Divider	824
Flushed Etched Circuits	825
Solenoid Pilots	826
Plastic Knobs	827
Synthetic Rubber Enamel	828
Flexible Coupling	829
Phase-Voltage Converter	830
Miniature Panel Meter	831
Engine-Oil Cooler	832
Solenoid Valves	833
Outlet Fitting	834
Blind Drive Rivet	835
Impulse Counters	836
Vent Valve	837
Glow Lamp	838
Electrolytic Level Sensor	839
Electrical Contacts	840
Speed Reducers	841
DC Motor	842
Aluminum Cases	843
Pressure Regulator	844
Data Amplifier	845
Control Valves	846
Thermostat	847
Magnetic Brakes	848
Motors and Generators	849
Transmission Chains	850
Hose and Hose Coup	851
Ball Bearings	852
Temperature Control	853
Pressure Regulator	854
Cable Clamps	855
Fluid-Power Cylinders	856
Synchro Indicator	857
Contactor	858
Damping Device	859
Gearmotor	860
Filters and Lubricators	861
Flexible Shaft Terminals	862
Diesel Control Panels	863
Plug Valves	864
Wireway Fittings	865
Speed Reducers	866
Thyrite Resistor	867
Sight Glass	868
Temperature Probes	869
Staked Fastener	870
Diaphragm Seal	871
General-Purpose Relay	872
Hydraulic Actuator	873
Metal O-Rings	874
Circuit Breakers	875
Aluminum Inserts	876
V-Belt Clutch	877
Ball Valve	878
Frequency Meter	879
Urea Formaldehyde Resin	880
Junction Transistor	881
Mercury Switch	882
Welding Contacts	883
Quick-Disconnect Connector	884
Pneumatic Valves	885
Wiring Clip	886
Electromagnetic Clutch	887
Valve Actuator Assemblies	888
Glass-Coated Capacitors	889
Pushbutton Switch	890
Threadless Pipe Fittings	891
Slip Ring Assembly	892
Lamination Treatment	893
Time-Control System	894
Cap Nuts	895
Back-Up Rings	896
Miniature Valve	897
Control Systems	898
AC Sensitive Relay	899
Nylon Coil Bobbins	900
Traverse Drive	901
Fluid Control Valve	902
Time Acceleration Switch	903
Accelerometer Systems	904
Rivet-Type Fastener	905
Universal Motor	906
AC Contactors	907
Ball Valves	908
Cylinders	909
Blower	910
Adjustable-Speed Drives	911
Electrical Connectors	912
Hydraulic Pump	913
Servo Analyzer	914
Oscillograph	915
Switch Template	916
Drafting Aids	917
Angle Calculator	918
Vibration Test System	919
Oscillograph Viewer	920
Dimetric Protractor	921
Oscilloscope	922
Digital Printer	923
Divider Setter	924
Power-Transient Analyser	925

MACHINE DESIGN
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401	431	461	491	521	551	581	611	641	671	701	731	761	791	821	851
402	432	462	492	522	552	582	612	642	672	702	732	762	792	822	852
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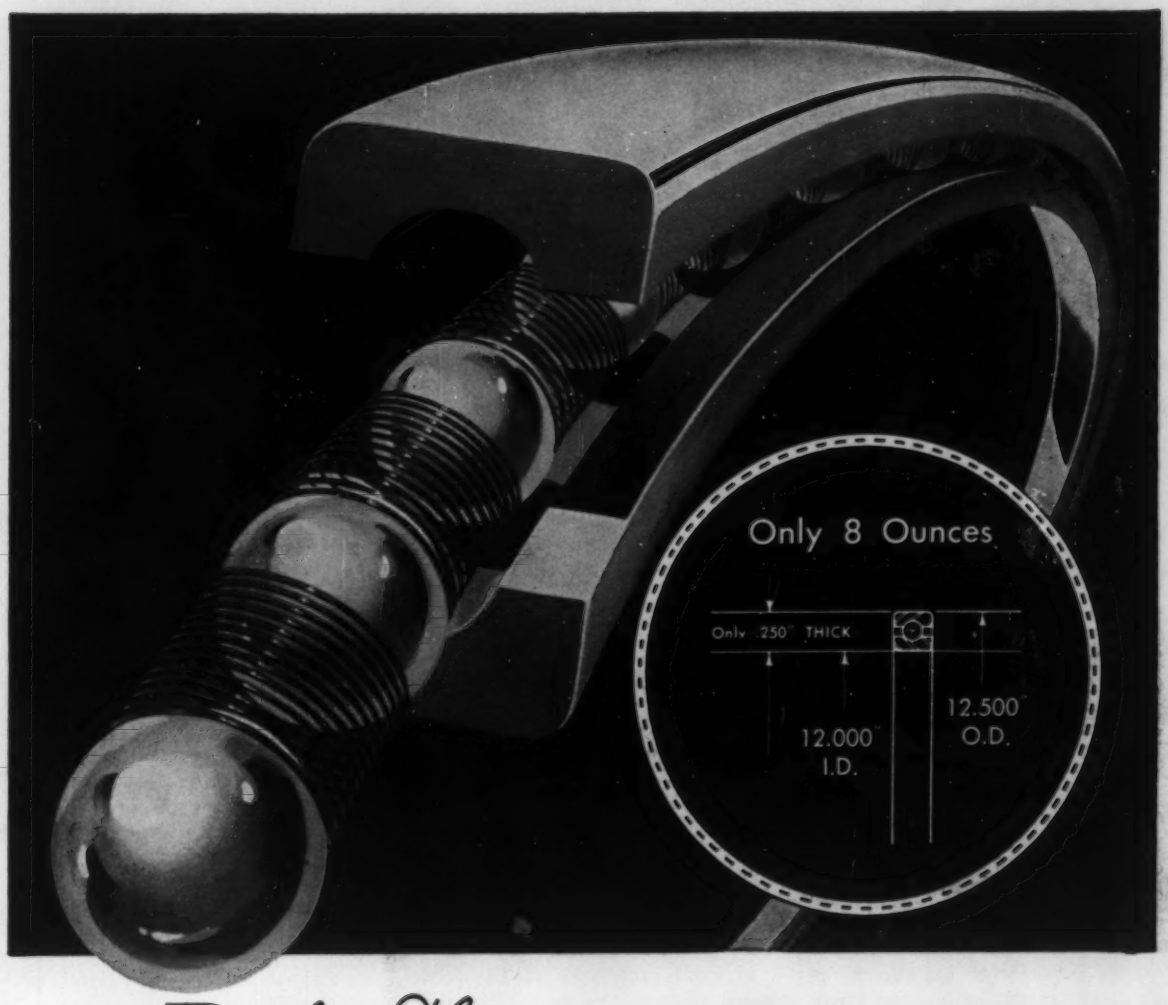

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world's thinnest radial ball bearing

HERE'S a typical example of Kaydon's *Reali-Slim* unique radial ball bearing that's finding wide application in practically every industry. *Reali-Slim* are the world's finest thin-section bearings and proportionately are thinner than a wedding ring. The bearing illustrated here is 12.000" I.D., 12.500" O.D., .250" thick — weighs less than 8 ounces. Designed for minimum weight and space limitations, it has a static load capacity of 5,520 lbs. and 894 lbs. at 100 rpm.

If you're looking for *Reali-Slim*, lightweight, radial ball or roller bearings, look at Kaydon's *Reali-Slim* line. Besides hundreds of standard *Reali-Slim* designs, there's a wide variety of special races, seals and separators to meet special bearing problems. What's more Kaydon is able to produce these *Reali-Slim*, high-precision bearings because Kaydon specializes in the unusual. In addition, Kaydon bearing engineers are prepared to give you valuable help with technical bearing application problems.

For complete data on *Reali-Slim* bearings for standard or special applications, ask for engineering Catalog No.54RS-2.

***Reali-Slim* Ball Bearings** — in Conrad, angular contact, 4-point contact and other types are available in seven standard cross sections from .250" to 1" and in bore diameters from 4" to 40".

***Reali-Slim* Roller Bearings** — in radial or taper roller types are available in cross sections from $\frac{1}{16}$" and in bore diameters from 5" to 40".

K-534

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All types of ball and roller bearings — 4" bore to 120" outside diameter . . .

Taper Roller • Roller Thrust • Roller Radial • Bi-Angular Roller • Spherical Roller • Ball Radial • Ball Thrust Bearings

(*Continued from Page* 15)
falls below stalling speed. Sudden braking without stalling is possible. Gas mileage is 50 mpg at an average speed of 37.5 mph. Top speed is 72 mph. Optional equipment includes a sliding roof panel, radio and white sidewall tires.

Aircraft Guided By System That Tallies Course Errors

Autopilot Needs No Help From Ground or Stars

NEW YORK, N.Y.—An automatic system that counts to itself has demonstrated the ability to guide aircraft without continuous reference to ground or celestial reference points. It need only know the starting point, the destination and the course. This is the ISIP system (Inertial System, Indicating Position) developed for the Navy by the Aeronautical Div. of Minneapolis-Honeywell Regulator Co.

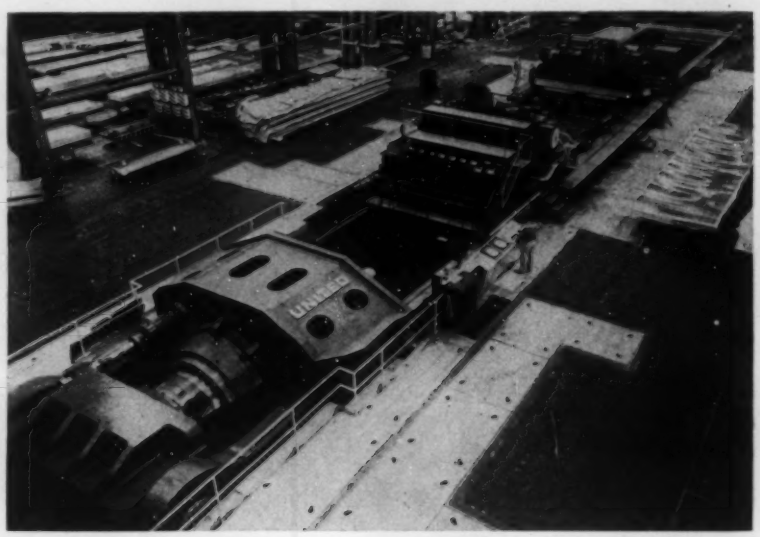
The system is not dependent on outside sources such as a human pilot, radar, star-tracking or radio commands which are used by many other types of inertial guidance systems. The ISIP system does not accept or broadcast signals, so it cannot be detected by known devices, nor can it be jammed by an enemy system.

The system keeps track of its position in inertial space by counting to itself units of acceleration in horizontal North-South and East-West directions. This counting process is continually integrated. The system, therefore, can tell itself at any time how far, how fast and in what direction it has come from its starting place.

Several prototypes of the complete system have been fabricated and Honeywell's Aeronautical Div. is in production on certain key components. These include a new inertial hermetic integrating gyroscope that can detect virtually infinitesimal rates of movements and a new pendulous gyro accelerometer.

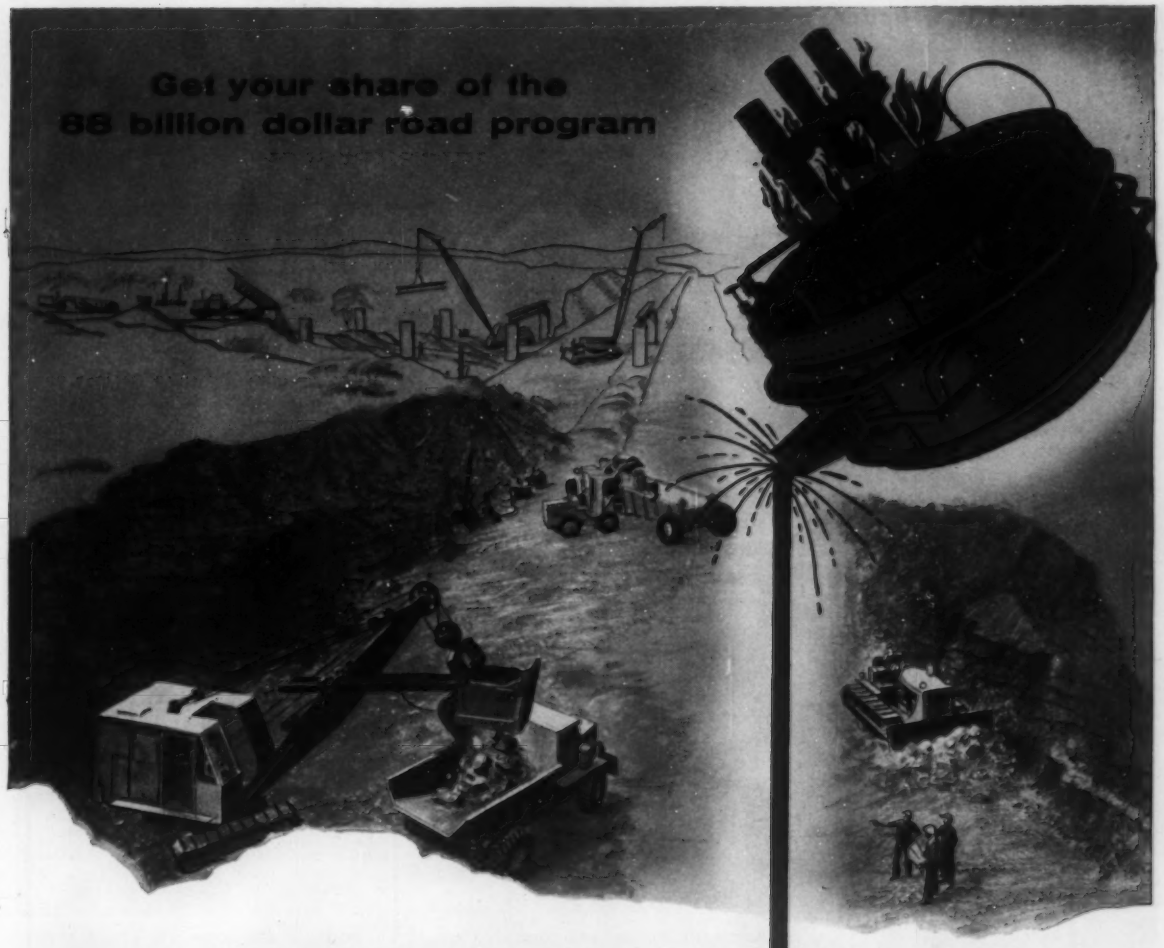
Other major components of the ISIP system include an ultraprecise electronic power supply, analog computers and a gyro-stabilized "platform" for the accelerometers.

Honeywell is developing other similar systems, and is now producing an inertial-type guidance reference system to be used in the satellite-launching rocket.



MODERN RACK exerts 16-million lb pulling force to reduce internal stresses on aluminum plate up to 6 in. thick, up to 90 ft long, and up to 12 ft wide. Dubbed the "monster," the machine is 182 ft long and weighs over 4.4 million lb. It will be dedicated shortly at Reynolds Metals Co.

THE MOST standard-equipment features of any Chrysler Corp. automobile are to be found on the new Imperial LeBaron four-door Southampton hardtop. This luxury-class car has a 325-hp engine, horizontal dual headlamps and solid-color interior. Exterior finish can be had in one of 21 solid colors.



LET THE STEEL WITH THE "BUILT-IN" PRODUCTIVITY HELP YOU

To produce the shovels, the trucks, the graders and other earth-moving giants, required to build America's 41,000 miles of badly needed roads, will provide manufacturers with their greatest peacetime challenge.

Aristoloy Leaded Steels, with their freer machining qualities, can help you contribute to this effort. Leaded alloy and carbon cut clean, yielding finer finish at faster feeds and speeds. Tools last longer, and many companies have been able to eliminate final machining.

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EXPORT: Copperweld Steel International Co., 225 Broadway, New York 7, N.Y.

Circle 414 on page 19

New Fasteners Beat the Heat

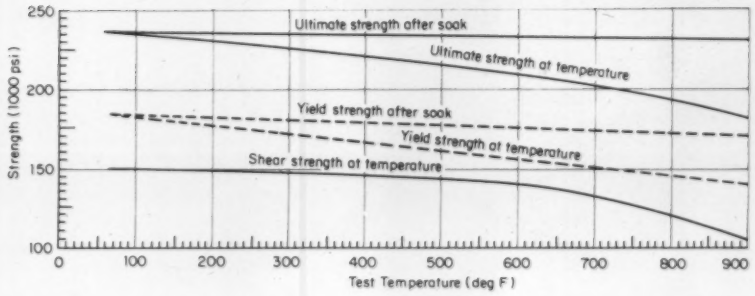
In missiles and high-speed aircraft, skin heating effects can send temperatures soaring. A new family of fasteners for aircraft structures combines a striking 220,000 psi tensile strength at room temperature with a startling 170,000 psi at 900 F.

REMARKABLE retention of strength at high temperatures is the feature of a new family of aircraft fasteners. Retaining a guaranteed 170,000 psi ultimate tensile strength at 900 F, the new fasteners are right in the Mach 3 to 4 class. They are stronger at 900 F than any military fastener specification requires at room temperature. Other properties—shear and fatigue strength, and stress rupture—are equally striking.

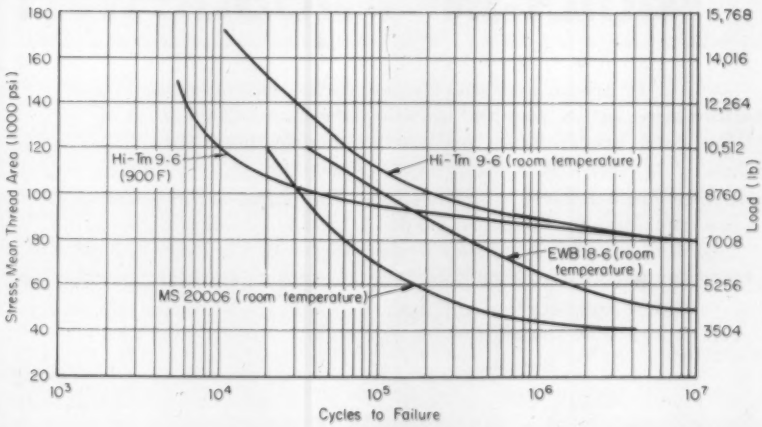
Secret of success in new Standard Pressed Steel Hi-Tm 9 fasteners is the use of a modified hot-work die steel. The 5 per cent chromium steel, Vascopet 1000 of Vanadium Alloys Steel Co., is a modification of Hotform die steel developed 24 years ago.

Room - temperature tensile strength is a minimum 220,000 psi, Tables 1 and 2, equal to the best of today's high-strength fasteners. Fatigue and impact strengths—important in practical fasteners—hold up well. Properties far surpass the minimums specified for MS-20004 series aircraft bolts, currently the strongest fasteners for which there is a general military specification.

Mach 3 flight at about 2100 mph involves skin heating effects that pose fastener problems. Missiles are already in the Mach 3 range, and aircraft designs in the Mach 3 to 4 class are just around the corner. The 900 F limit on the



Strength versus temperature for $\frac{3}{8}$-24 bolts in the new Hi-Tm 9 series. Ultimate tensile strength at 900 F is guaranteed at 170,000 psi. Specimens tested at temperature were soaked for 1 hr; specimens tested after soak were soaked at temperature for 100 hr and tested at room temperature.



Comparison of tension-tension fatigue data for $\frac{3}{8}$-24 aircraft bolts. MS-20006 fastener is current high-strength aircraft fastener; EWB 18-6 is 180,000 psi tension bolt. Endurance limits of Hi-Tm bolts are the same for room temperature and 900 F.

"Inside-out" bushing
This drawn strip type bushing is lined on the outside diameter with Federaloy HF-16 leaded bronze.
The I.D. and the flange are both bearing surfaces on this formed bushing
Drawn and flanged strip type bushing, lined on the I.D. and the thrust face with Federaloy HF-16 leaded bronze.
The bushing with the bearing surface where you want it
I.D. or O.D. or both of this formed steel bushing can be lined with our sintered copper-alloy.

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Our formed bushings and thrust washers are widely used for automatic transmission and other applications. They can be solid bronze or steel lined on either or both surfaces. Washers can be "lined" on both faces. Many special features can be incorporated—grooves, holes, nibs, ball indenting; straight, special or locking seams. We provide complete engineering service. Address:

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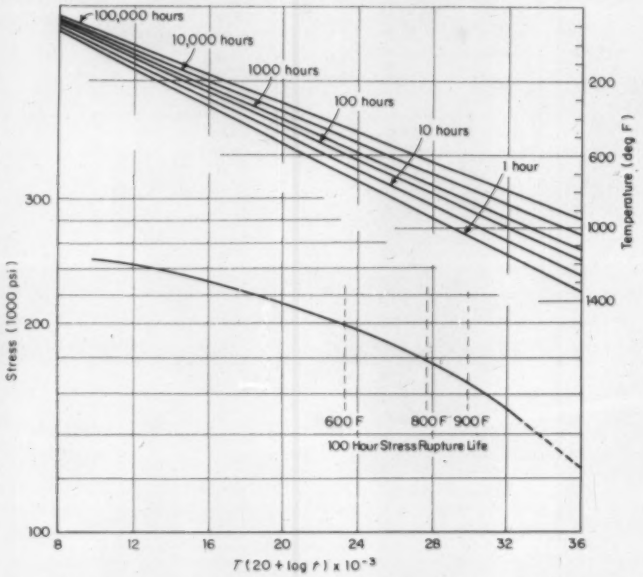
Circle 415 on page 19



Larsen-Miller curves for Hi-Tm 9 bolts, used to obtain stress-rupture data. An empirical curve is plotted from tensile tests at temperature according to equation shown on X-axis (T is temperature, deg F abs; t is time, hr). Time at temperature is located on upper section of chart; a vertical line is dropped to curve; and stress rupture value is read at left.

new fasteners places them squarely in the Mach 3 to 4 class.

Although initial fasteners are 12-point external-wrenching head tension types, shear and tension fasteners are planned with similar physicals. Applications, in addition to airframe structures and aircraft power plants, could include power plant turbines, nuclear vessels, and high temperature and pressure chemical processes. Companion Flexloc one-piece self-locking locknuts will be made of AMS 6304 alloy steel, since requirements for nuts are not as severe as for bolts.

Diffused nickel-cadmium plating is used for corrosion resistance instead of conventional cadmium plating. Cadmium melts just above 600 F and diffuses into the bolt metal, causing embrittlement. The new plating is applied as separate layers of nickel and cadmium. Thermal treatment then diffuses the two as an alloy good up to 1000 F.

Development of the new fastener series followed a crash program initiated in December 1955, shortly after a Boeing airframe symposium on the West Coast outlined requirements for Mach 3-4 air-

Table 1—Minimum Specifications for Hi-Tm 9 Bolts

	Room Temperature	Tested at Room Temp. after 100 hr Soak at 900 F	Tested at 900 F
Ultimate tensile strength (psi, min)	220,000	220,000	170,000
Yield strength, 2% offset (psi, min)	185,000	185,000	140,000
Elongation in 4 diameters (per cent, min)	10	10	16
Reduction of area (per cent, min)	35	35	50
Shear strength (psi, min)	130,000	130,000	110,000
Stress rupture, 100 hr (psi)	.....	.....	130,000
Fatigue strength, tension-tension, 10% preload at 8 million cycles (psi)	80,000	55,000	80,000
Impact strength (ft-lb)	18	18	23

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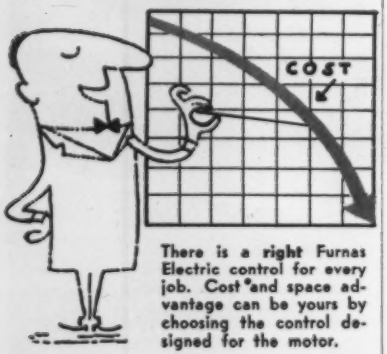
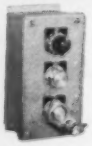


There is a right Furnas Electric control for every job. Cost and space advantage can be yours by choosing the control designed for the motor.

Furnas Magnetic Starters are available through Size 4 in 10, instead of the usual 5, different sizes from 1 to 100 hp. This provides "In-Between" sizes, not otherwise available, at corresponding price and space advantages.

Drum Controllers — over 1000 models available from 1 to 10 hp. for whatever application you require.

Oil Tight Push Buttons for every need. Standardization and interchangeability mean more combinations with fewer parts. Complete accessory line.



Pressure Switches | Limit Switches | Foot Switches

For more information write for Bulletin 5411, 1045 McKee St., Batavia, Illinois.

FURNAS ELECTRIC COMPANY
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Circle 416 on page 19

New resilient clutch facings operate at 400 psi or higher

A new group of resilient friction materials that operate at closing pressures of 400 psi and ambient temperatures up to 315° F. has been developed by Armstrong research engineers.

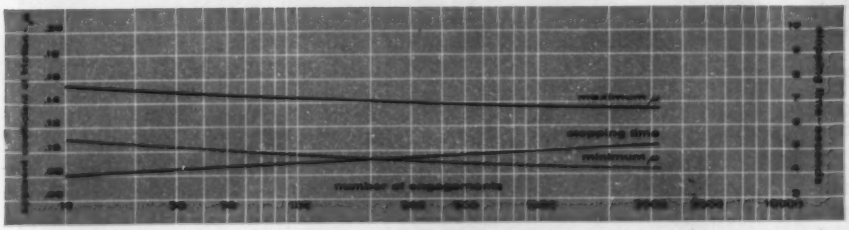
These new materials meet the demands of modern automatic transmissions where increased engine horsepower and design changes have combined to impose sharply higher loads on clutch facings.

The new compositions are made by an entirely new patented process that combines inorganic and organic fibers with synthetic saturants. The new materials have high capacity and show virtually no change in coefficient of friction during their long service life.

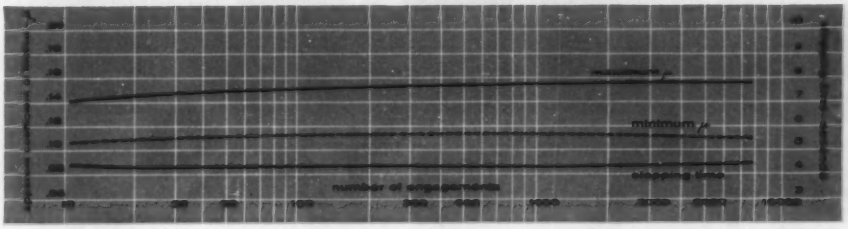
Although designed for use at ambient temperatures of 315° F., the new materials are not affected by the much higher flash temperatures often encountered during severe engagement. They have been operated in some experimental transmissions at closing pressures as high as 2,000 psi.

The curves below compare the test performance of one of the new compositions with a friction material that has been used successfully in millions of automatic transmissions. For more information, and a copy of our booklet on these new friction facings, write to Armstrong Cork Company, Industrial Division, 7205 Dean Street, Lancaster, Pennsylvania.

The curves shown below, called "fade curves," were plotted from tests run on the Armstrong wet friction dynamometer. In this machine, a single test clutch plate (7½" O.D., 6¼" I.D., faced both sides) is engaged and disengaged thousands of times, each time absorbing the 28,000 foot-pounds of kinetic energy which the machine develops at 1,000 rpm. During each engagement, three factors are graphically recorded: maximum coefficient of friction, minimum coefficient of friction, and stopping time.



This fade curve shows the performance under test of a typical clutch plate faced half-and-half with a standard resilient cork facing and a resin-saturated paper. This type facing has been used with excellent results in millions of automatic transmissions. Ideally, these curves would be parallel, reflecting no change from the first engagement to the last. Under severe test, however, the coefficient of friction curves both fall off, while the stopping time increases.



This fade curve shows the performance of the new Armstrong FM-45 material during a test covering 7,500 engagements. Note that the curves more nearly approach the horizontal than the previously acceptable material charted above. This indicates a marked improvement in actual performance.

Armstrong RESILIENT FRICTION MATERIALS

. . . used wherever performance counts

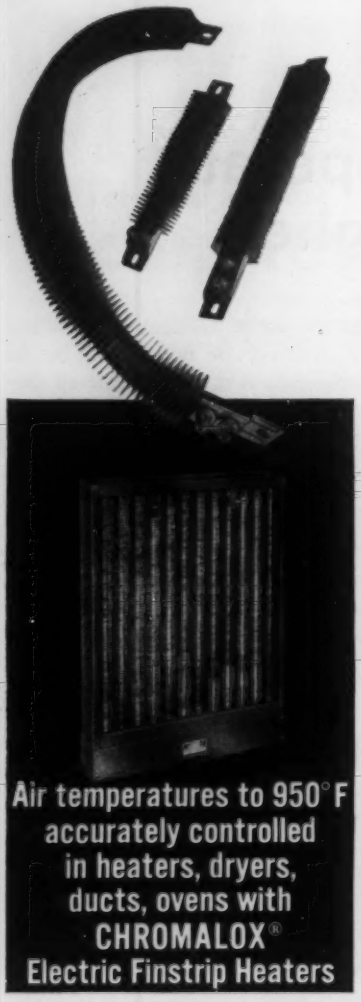
Table 2—Bolt Tensile Strength Comparison*

	Room Temp.	800 F	900 F
Hi Tm 9 (Vascojet 1000)	220,000 min	190,000	170,000
AMS 5616 (stainless)	145,000	105,000	95–100,000
AMS 6304 (alloy steel)	145,000	123,000	110–120,000

*Values in psi. Data for bolts, not plain specimens for which properties would be higher.

craft. At that time, hardware for an 800 F skin temperature was asked for. Main problem was finding the proper material; 25 likely candidates were selected and eliminated one-by-one before the 5 per cent chromium hot-work die steel was selected.

POWDER-POWERED TOOLS are being investigated at Lockheed for the shaping and joining of metals to be used in ultrahigh-speed aircraft. New methods are needed because aircraft materials that resist the heat of fast flight are tougher and harder than ordinary tools. Unlike existing stud-drivers, in which tools are driven by explosions, the Lockheed method applies the force of explosion directly to workpieces. Several early explosive drills are held above by Lockheed experimenters. Also seen are several plane parts formed to the shape of dies by the pressure of explosions. Noise and risk of explosive metalworking is claimed moderate but Lockheed tests occur in a converted bomb shelter.



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CHROMALOX
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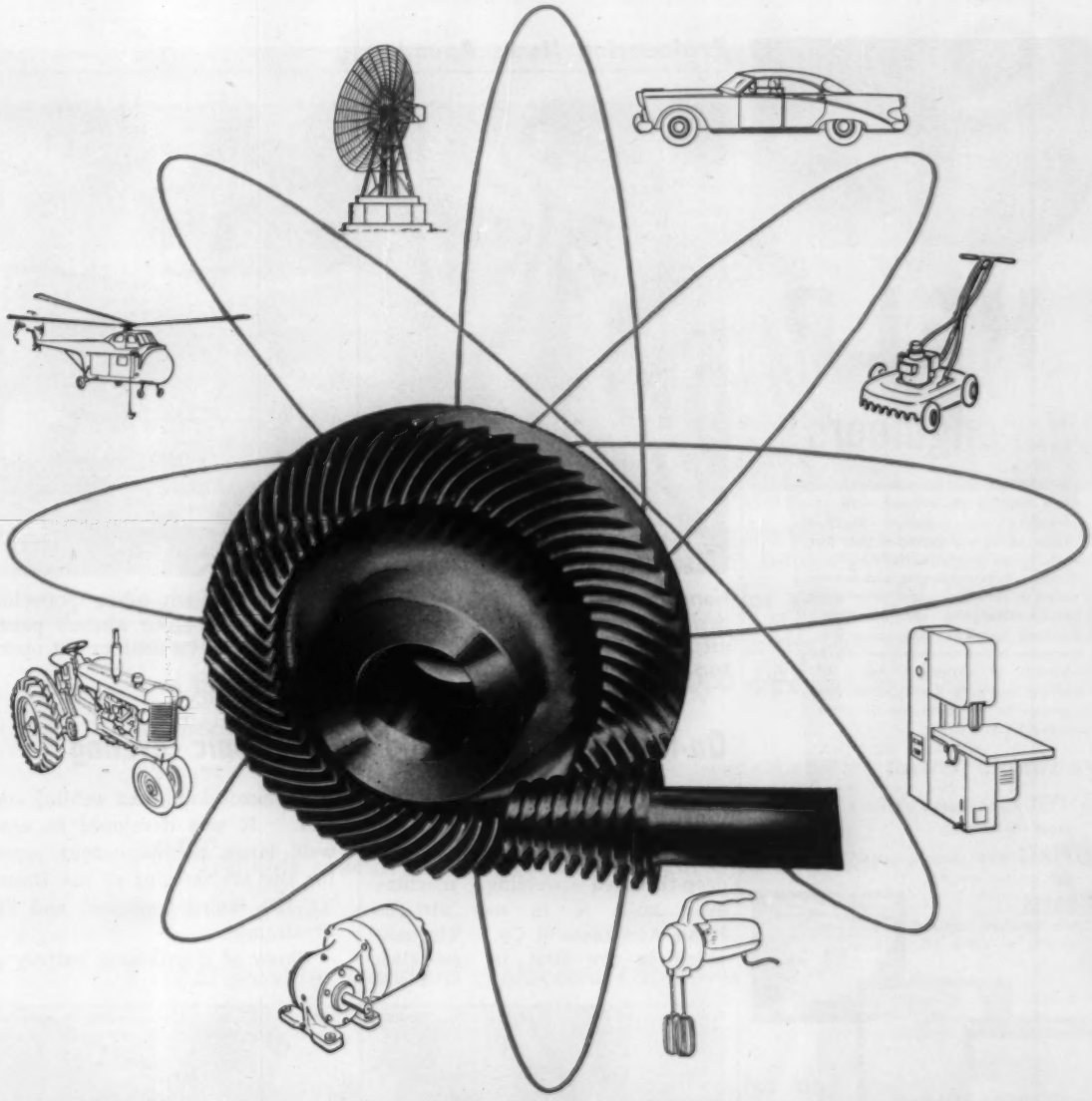

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Spiroid® Hobs for producing Spiroid Gears are available only from Illinois Tool Works.

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Circle 419 on page 19

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so simple to use:
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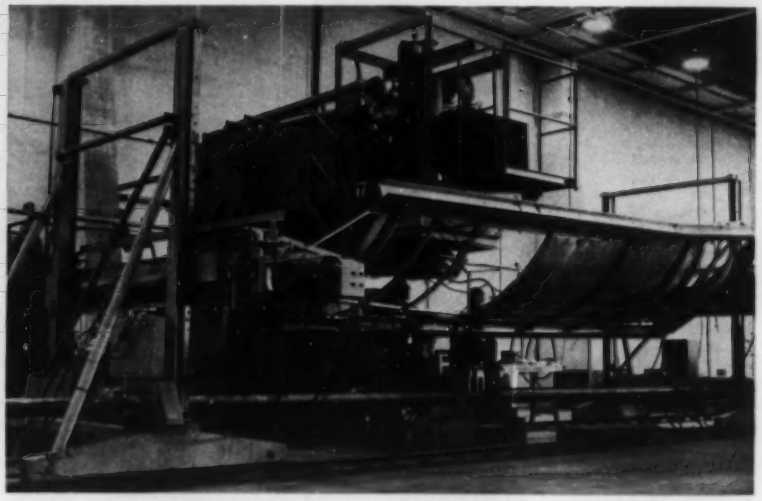


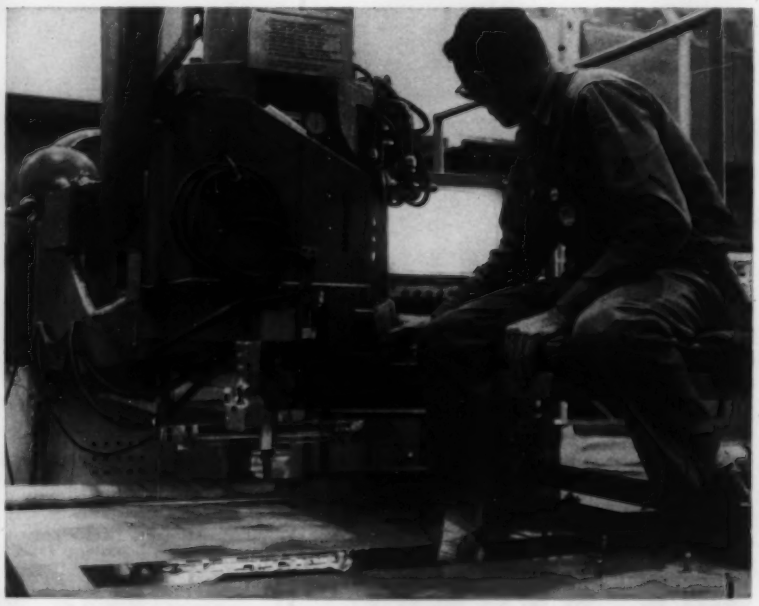
Contour welder's 54 by 73-in. throat is larger than any other spotwelder designed for certified structural welding. Double-contour aircraft panels are positioned electronically. Closed-circuit TV may be used to aid operators controlling directional movement.

On-the-Spot Spotwelding by Electronic Leveling

Tape Commands Set Spot Space

SAN DIEGO, CALIF.—The largest deep-throated welding machine ever built is in use at the Ryan Aeronautical Co. The machine is the first to use electronic positioning and welding control. It was developed to spotweld large, double-contour panels for the aft sections of the Boeing KC-135 tanker-transport and 707 Stratoliner.

Three of a proposed battery of



Television receiver relays an under-the-table image of spotwelds to the operator. The TV circuit is an inspection aid in maintaining quality control.

How to lower your production cost with the right Spindle for your job and the right Spindle Service

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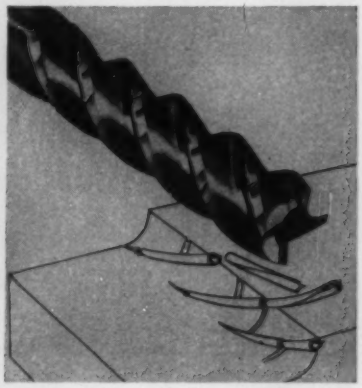
"PIONEERS IN INVESTMENT CASTING"

News Roundup



NUMEROUS FRESH BITES enable this new end mill by DoAll Co. to produce accurate, uniform cuts in titanium, stainless steel and similar tough metals. Grooves in the mill teeth produce ridges on the work which facilitate penetration of succeeding teeth. Staggered groove spacing clears all ridges from finished work. Grooves also break and clear chips to prevent tool deflection, poor surface finish.

nine machines are in use. Each machine is 13½ ft high, weighs over 58,000 lb and has a 54-in. by 73-in. throat. A three-phase, 250-kv transformer weighing 25,000 lb supplies the 100,000-amp welding current. A 2000-kw transformer will serve the nine machines.

A sensor-leveling system responds to electronic commands while guiding the panels through the electrodes. A sensor head, the nerve center of the positioning table, controls the level positioning of the skin as it contacts the electrodes. Two nylon sensor knobs control vertical motion by means of right and left table elevators. Two other knobs control rolling motion by rotating the frame with skin attached. Scratching is eliminated by automatically raising the panel ⅛-in. above the electrode. On the command to weld, the panel is lowered onto the electrode.

The first spotweld is located manually. The remainder are located by tape commands which provide directional and spacing control by means of a seven-command punched tape. Ten different

double-contour skin assemblies are spotwelded, each with it own tape. A tracing head mounted adjacent to the upper electrode follows skin curvature and provides uniform edge-distance spacing.

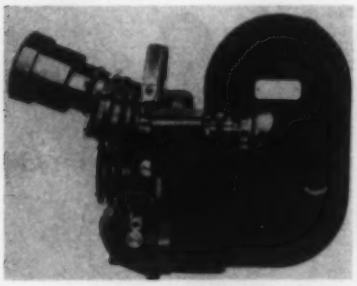
Single-contour positioning tables feature an electronic counting system for predetermined spacing of spotwelds. A photoelectric cell counts a number of light spaces and stops the movement of the panel. The welder then fires automatically. A television camera is mounted beneath the table of the flat positioner for inspection purposes. A similar camera may be mounted on the double-contour positioner to aid operators controlling directional movement.

French Camera Needs No Help On Varied Assignments

Built-In Accessories Enable Time-Lapse Shots

HOLLYWOOD, CALIF.—World's most versatile camera is claimed for the newest Camerette model, developed in France and marketed in the U.S. by Houston Fearless Div. of Color Corp. of America.

Available as 35-mm or 16/35-mm combination, the Camerette is equipped with accessories that adapt it in seconds to varied photographic requirements. It is equipped for documentary photography, data recording, missile tracking, air-to-air shots, time-lapse photographs, X-ray cinematography, microphotography, and instrumentation analysis. It can be remotely controlled with time or frame counter on film edges.



Mechanical and optical features

(*Continued on Page* 36)

Pin is inserted and collar placed on bolt, gun then engages pull grooves, draws material together and pulls pin into hole. Collar is swaged into locking grooves and pin tail then is broken off at breaknock groove. Action takes place in the time it takes to pull trigger.

This quick demonstration at your desk will show how to get superior, more economical fastening with TOWNSEND LOCKBOLTS*

In a few minutes we can show how Townsend lockbolts will give you superior fastening at lower installed cost and improve your products. A Townsend engineer will demonstrate the ease with which they can be installed, and prove their high resistance to vibration and shock.

Townsend lockbolts provide a higher clinch, or clamping action than rivets, and more uniform fastening than nuts and bolts. They fill the hole better than other fasteners, have high tensile pre-load, make a more rigid joint and provide an effective liquid seal. Available in both steel and aluminum alloy in a variety of diameters and lengths—two head styles.

For a demonstration of how Townsend lockbolts will improve your fastening while lowering the cost, write to Townsend Company, P.O. Box 237-E, New Brighton, Pa.

*Licensed under Huck patents RE 22,792; 2,114,493; 2,527,307; 2,531,048; 2,531,049 and 2,754,703

See Lockbolts Demonstrated At The Design Engineering Show—Booth 1139

The Fastening Authority

Townsend

COMPANY • ESTABLISHED 1816

NEW BRIGHTON, PENNSYLVANIA

Sales Offices in Principal Cities

Cherry River Division • Santa Ana, California

Circle 423 on page 19

STOP

BOOTH 705

... AT THE DESIGN ENGINEERING SHOW

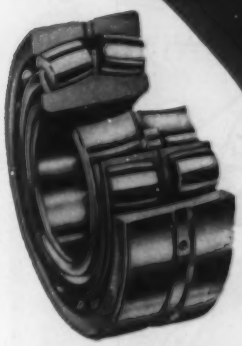
LOOK

... AT THE NEW LINE OF SKF BEARINGS

LEARN

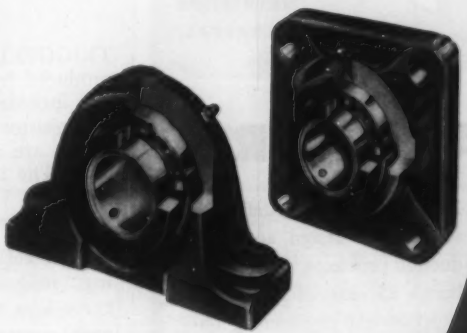
... HOW SKF CAN HELP YOU

When you visit the Design Engineering Show at the New York Coliseum, May 20 to 23, SKF will show the world's finest, most extensive and versatile assortment of anti-friction bearings. Here are just a few of the high spots of interest:



- The newly-improved Type "C" spherical roller bearing which gets lubrication where needed—at the center... gives increased capacity and life.
- New cast steel housings for heavy-duty service where cast iron housings will not meet rugged requirements.
- Complete line of unit pillow blocks and flanged housings with external dirt flingers and internal Fairprene seals that retain lubricant.
- Famous SKF ball bearing line available with any of 18 combinations of seals, shields and snap rings.
- Ty Seal Tapered Roller Bearing, that is easy to install and keep clean... prelubricated... Neoprene sealed.

7768



Stop in and let us show you the right bearing for your needs. Or, call your SKF distributor or SKF Sales Engineer.

SKF

Ball Bearings
Cylindrical Roller Bearings
Spherical Roller Bearings
Tapered Roller Bearings ("Tyson")

Circle 424 on page 19

Mr. Auburn says:

BY

AUBURN

For a quick and definitive solution to design and production problems, call on Auburn's 85 years of specialized experience in engineering materials to specific sealing and packing applications. Send us your prints and specifications — you'll get our recommendations and quotations promptly!

Our extremely wide range of materials includes:

Leather • Asbestos • Teflon • Silicone Rubber • Neoprene Rubber • Cork • Fiber • Compositions • Phenolics • Cloth • Paper • Cardboard • Plastics • Brass • Steel • Copper • Aluminum • Kel-F • Fibreglas • Other Special Materials.

GASKETS ALGCO PACKINGS

THE

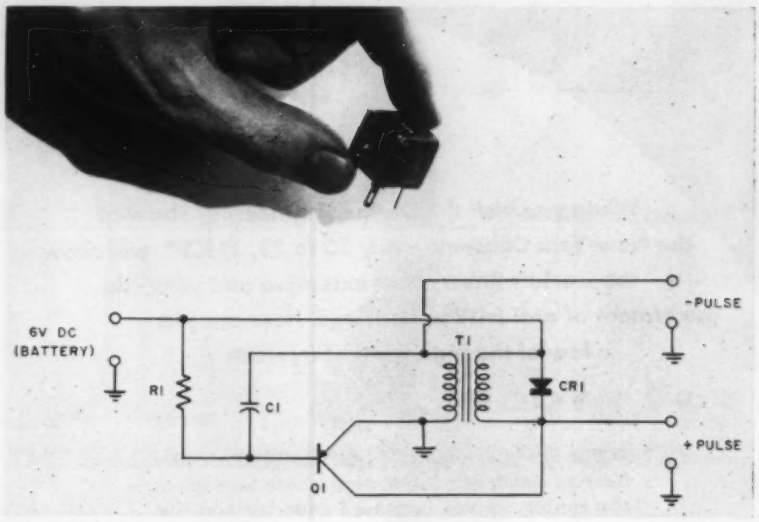
AUBURN

MANUFACTURING COMPANY

306F Stack Street, Middletown, Conn.

Representatives: Atlanta, Ga. • Detroit Mich. • St. Louis, Mo. • Los Angeles, Cal. • Minneapolis, Minn. • Washington, D.C. • New York, N.Y. • Cincinnati, O. • Rochester, N. Y. • Pittsburgh, Pa. • Fort Worth Tex.

Circle 425 on page 19



TRIGGERING ELECTRONIC PULSES of 3-microseconds duration are produced by this Du Mont Pulse Cube. Complete blocking oscillator circuit includes a subminiature Du Mont pulse transformer, transistor, capacitor, resistor, and crystal diode all within a ¾-in. molded epoxy resin cube. Pulses are identical to those obtained from more elaborate pulse generators. The unit can run on a miniature 6-v mercury cell for 1000 hr.

include reflex viewing during filming, magazine loading, divergent three-lens turret, lightweight die-cast construction, interchangeable drive, and rapid dovetail mount for accessory equipment.

The new 16/35-mm Camerette can use either 16-mm or 35-mm film. The changeover is made in seconds. A stock Camerette lens is the variable focal length, zoom type available for both 16-mm and 35-mm film.

Magazines have either 400-ft or 100-ft capacities.

Graphic Symbols for Process Flow Diagrams is the subject of a tentative trial standard currently being circulated for criticism and comment. Sponsors are the American Society of Mechanical Engineers and the American Society of Electrical Engineers. The standard provides a preliminary set of symbols developed for use on basic process flow diagrams. The symbols represent major items of equipment used by the petroleum and chemical industries. Free copies are available from Frank Philippbar, Standards Dept., ASME, 29 West 39th St., New York 18, N. Y. All requests should be made on company letterhead.

Meetings

AND EXPOSITIONS

May 22-23—

American Iron and Steel Institute. Annual Meeting to be held at the Waldorf-Astoria Hotel, New York. Additional information can be obtained from institute headquarters, 350 Fifth Ave., New York 1, N. Y.

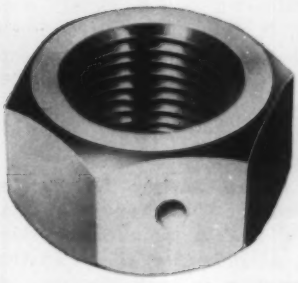
June 2-5—

American Gear Manufacturers Association. Annual Meeting to be held at the Homestead, Hot Springs, Va. Further information can be obtained from association headquarters, 1 Thomas Circle, Washington 5, D. C.

June 2-7—

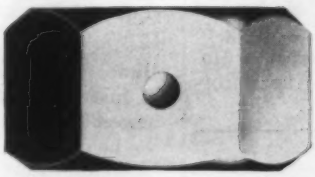
Society of Automotive Engineers. Summer Meeting to be held at

THE M·F TWO-WAY LOCK NUT



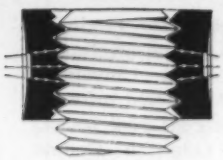
DOUBLE CHAMFERED ALL-METAL RE-USABLE

Starts from either end—locks in body of nut, not at the crown.



For fast, sure, *automated* application, the *Two-Way* Lock Nut has no equal in cost to purchase and apply. This nut may be applied from either side — automated *without selective devices.*

MORE LOCKING POWER WHEN BOLT ENDS MUST BE FLUSH WITH NUT



Because the locking device is *in the body* of the nut, not at the ends, the lock is farther from the end of the bolt—a more positive lock when the bolt is flush—(or even when all threads are not used).

TWO LOCKING PRINCIPLES—TWO POINTS OF LOCK

Ovalized as well as deflected at point of lock. Opposing center pressure points give 180° spring. Simplicity is the key to the M-F Two-Way Lock Nut's locking power as well as its *consistent* torque.

AMERICAN STANDARD FINISHED HEXAGON STEEL "M-F" TWO-WAY LOCK NUT

SIZE	THREADS PER INCH	THREADS PER INCH	FULL THICKNESS †			
			WIDTH ACROSS	THICKNESS	WEIGHT PER 1000	NUMBER IN KEG
* 10	32	24	3/16	7/32	7.2	20,000
1/4	28	20	3/16	7/32	7.2	20,000
5/16	24	18	1/2	17/64	10.6	14,000
3/8	24	16	5/16	21/64	15.3	8500
3/8	20	14	3/8	3/8	27.8	6000
3/8	20	14	11/16	3/8	27.8	6000
1/2	20	13	3/4	7/16	36.0	5000
5/16	18	12	7/8	31/64	56.2	3300
3/8	18	11	15/16	35/64	69.2	2500
3/4	16	10	1 1/8	41/64	127	1500

*In 1/4" Blank
**Light Series
† Available Jam Thickness in 1/2" and Over.
Your Inquiry Welcomed for Other Sizes.

MAC LEAN-FOGG HAS A COMPLETE LINE OF LOCK NUTS, WELD NUTS, AND SEMI-FINISHED NUTS

WELD NUTS
Fast positioning, spatter protected weld nuts—pilot or recessed type.

M-F SPEED HOLDING NUT NO. 2 spins on . . . locks and holds.

M-F LOCK NUT NO. 1 locks on a common nut.

THE FAMOUS M·F *Uni-Torque*® LOCK NUT

M-F Uni-Torque Lock Nut locks in position and stays there. *This* lock nut has a record for consistency of torque never before thought possible.

SEMI-FINISHED NUTS of close tolerance—high quality. Standard sizes, full and jam thicknesses . . . in stock . . . call for immediate delivery.

WRITE FOR CATALOGUE WITH COMPLETE STANDARDS, TORQUE CHARTS, ETC.

ENGINEERING SPECIFICATIONS FOR THE M·F TWO-WAY LOCK NUT

Friction induced by deflection of threads in the body of the nut as well as a slight ovalizing in the center of the body, allows this nut to spin on *from either end* and lock in any position after deflected area is reached—does not need to be seated.

It is carried in stock—is an all metal nut, available in all the usual metals for nuts.

It will *re-apply* repeatedly.

Threads: Unified coarse or fine, American Standard, Class 2B. ASA B1.1—1949.

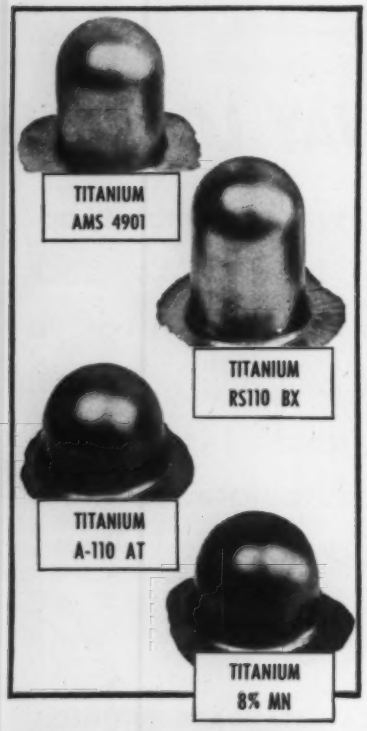
Manufactured to specifications and tolerances listed in ASA, B-18.2, 1955.

U. S. PATENT NO. 2,686,546

MAC LEAN-FOGG *Lock Nut Company*

5535 N. Wolcott Ave., Chicago 40, Ill. In Canada: The Holden Co., Ltd., Montreal

Circle 426 on page 19



Titanium Cylinders drawn in one stroke on the same die

Titanium, magnesium, zirconium, stainless and aluminum 2024 are deep drawn in one operation by Brooks & Perkins.

Cost of staging dies and intermediate anneals is eliminated.

. . . Whenever you are faced with a difficult or delicate operation-problem in Magnesium or Titanium, a talk with B&P engineers is well worth while.

Engineering Facilities in Detroit and Los Angeles

. . . Write for Titanium and Magnesium engineering data — also folder on B&P's facilities to handle tough jobs.

BROOKS & PERKINS, Inc.

Magnesium-Titanium Fabrication
Magnesium and Boral Sheet and Plate

1940 West Fort St.
Detroit 16, Mich.
Phone: TAshmoo 5-5900
IN LOS ANGELES:
11655 Vanowen St.
North Hollywood, Cal.
Phone: STanley 7-9665

56-C

OFFICES IN NEW YORK, WASHINGTON, DALLAS

Circle 427 on page 19

Engineering News Roundup

Chalfonte-Haddon Hall, Atlantic City, N. J. Further information is available from society headquarters, 485 Lexington Ave., New York 17, N. Y.

June 3-5—

American Society of Refrigerating Engineers. 53rd Annual Meeting to be held at Hotel Fontainebleau, Miami Beach, Fla. Additional information can be obtained from society headquarters, 234 Fifth Ave., New York 1, N. Y.

June 9-13—

American Society of Mechanical Engineers. Semiannual Meeting to be held at the Sheraton-Palace Hotel, San Francisco. Further information can be obtained from society headquarters, 29 W. 39th St., New York 18, N. Y.

"Too much wax on it again?"

June 11-13—

Third Western Plant Maintenance and Engineering Show and Conference to be held at the Civic Auditorium, San Francisco. Additional information is available from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

June 13-14—

Malleable Founders' Society. Annual Meeting to be held at the Broadmoor Hotel, Colorado Springs, Colo. Additional information is available from society headquarters, 1800 Union Commerce Bldg., Cleveland 14, O.

June 16-20—

American Electroplaters' Society. Annual Meeting to be held at Sheraton-Mt. Royal Hotel, Montreal, P. Q. Further information can be obtained from society headquarters, 445 Broad St., Newark, N. J.

June 16-21—

American Society for Testing Materials. 60th Annual Meeting to be held at Chalfonte-Haddon Hall, Atlantic City, N. J. Further information is available from society headquarters, 1916 Race St., Philadelphia 3, Pa.

June 17-20—

Institute of the Aeronautical Sciences. National Summer Meeting to be held at the Biltmore Hotel, Los Angeles. Further information can be obtained from institute headquarters, 2 E. 64th St., New York 21, N. Y.

June 17-21—

American Society for Engineering Education. Annual Meeting to be held at Cornell University, Ithaca, N. Y. Additional information can be obtained from society secretary, W. Leighton Collins, University of Illinois, Urbana, Ill.

June 19-22—

Drop Forging Association. Annual Meeting to be held at Grand Hotel, Mackinac Island, Mich. Additional information can be obtained from the association, 419 S. Walnut St., Lansing 33, Mich.

June 23-25—

Alloy Casting Institute. Annual Meeting to be held at the Homestead, Hot Springs, Va. Additional information is available from institute headquarters, 32 Third Ave., Mineola, N. Y.

June 24-28—

American Institute of Electrical Engineers. Summer General Meeting to be held at Sheraton-Mt. Royal Hotel, Montreal, P. Q. Further information is available from institute headquarters, 33 W. 39th St., New York 18, N. Y.

COMPUTER TECHNIQUES

solve special gear and cutter designs

Giving designers exceptional freedom in their specifications for special gears to improve design, the electronic computer easily makes the calculations necessary for making cutting tools to meet the most critical requirements. This high-speed Bendix Computer shortens hours of calculation to minutes, permitting complete mathematical study of complex problems.

A punched tape holds the basic formulae, the computer program. Variables for a particular Fellows Cutter, Shaving Tool, or Master Gear are typed on an electric typewriter which feeds them into the computer. As fast as the operator can type, the computer does the figuring which used to require hours of labor.

Fellows Gear Shapers tooled with Fellows Cutters lower costs and speed production on internal and external spur, helical and herringbone gears. Many examples of interest to designers are shown in the booklet, "The Art of Generating with a Reciprocating Tool." Just write any Fellows office for your copy.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices:
1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

THE PRECISION LINE

Fellows *Gear Production Equipment*

Circle 428 on page 19

4 NEW design aids providing working data for every ELECTRONIC CABLE Problem

...available from Pacific Automation Products, a company established to provide a product as well as a service, which utilizes a 50,000 sq. ft. factory and an experienced staff of qualified engineers and technicians to design, manufacture and install custom made neoprene jacketed cable for the vast electronic industry.

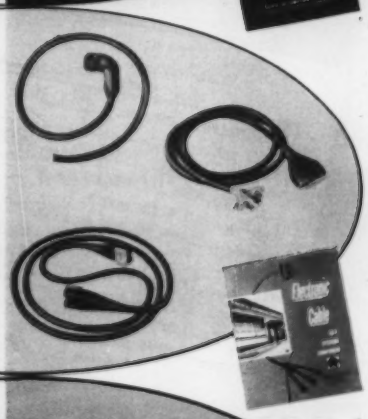
Engineers and technicians are invited to investigate career opportunities with us. Submit resume for interview.

CABLE SPECIFICATIONS

"Design Engineering Specification" Bulletin No. PAP-C-101. Comprehensive 19-page engineering manual describing materials, construction, design criteria, specification conformance, performance, identification, documentation and other important features determining correct cable for your specific application.

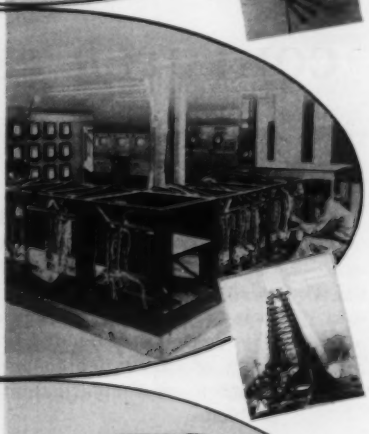
CABLE AS A COMPONENT

"Electronic Cable as a Systems Component" Bulletin No. 656. Generously illustrated pamphlet describes design and production of electronic cable in bulk and assemblies. Connectors and hardware; cable breakouts; environmental requirements; voltage rating, testing; cable procurement data — are some of the subjects covered in this bulletin.



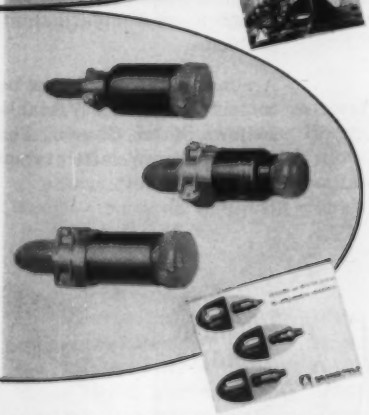
CABLE SYSTEMS

"Engineered Cable Systems" Bulletin 357. Illustrated brochure describing Pacific Automation Products' pioneering in the use of the Systems Concept to coordinate cable design with the development of complex electronic systems. Liaison engineering teams cooperating with systems design groups establish cable as integral part of system, supervising cable construction concurrently with development of other elements.



CABLE ACCESSORIES

"Extension and Adapter Sleeves for Cable/Connector Compatibility" Bulletin 257. Illustrated bulletin on aluminum adapters designed and manufactured by Pacific Automation Products, which for the first time provide a means of attaching any size AN connector to any size cable, with assured reliability.

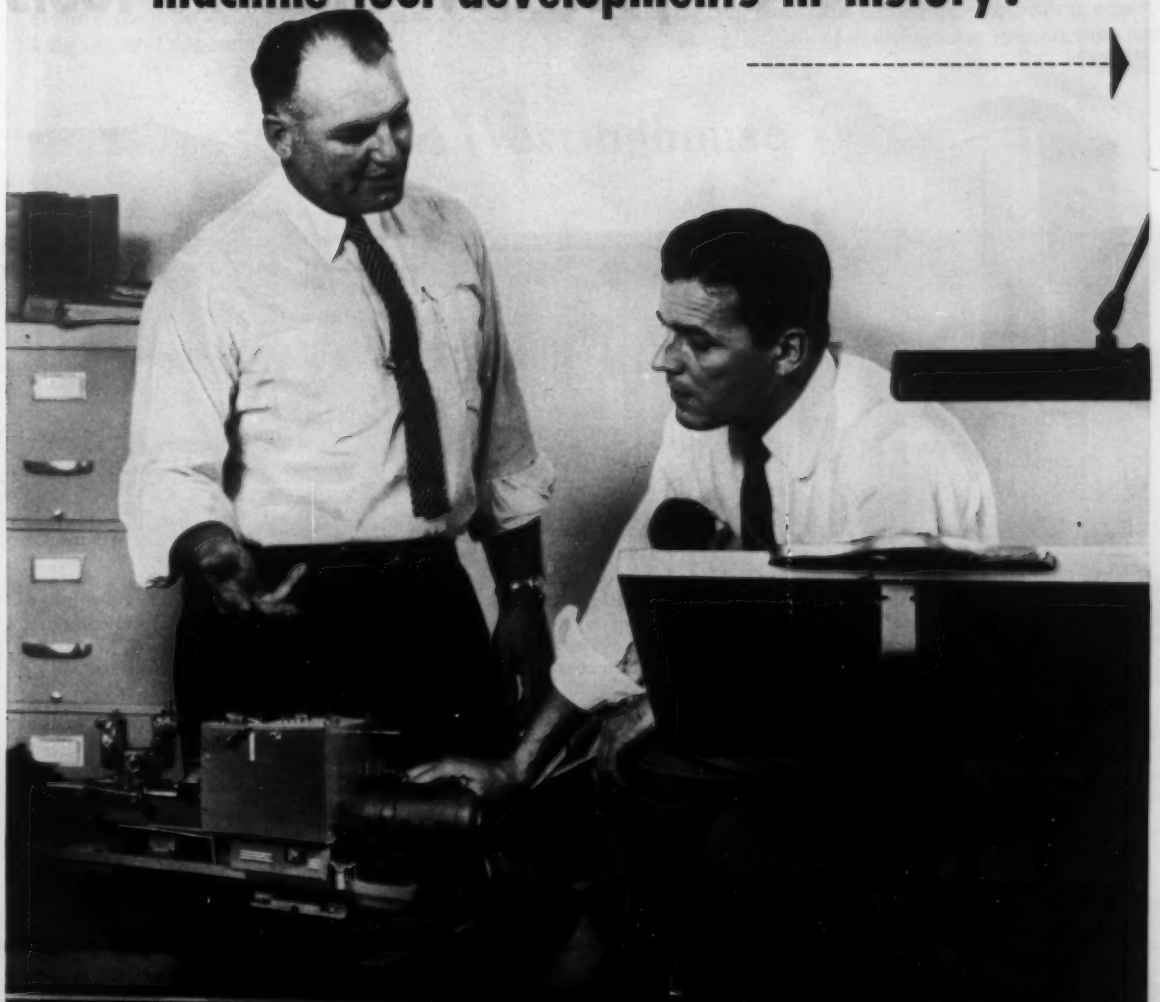


Pacific Automation Products, Inc.
CHapman 5-6871 • TWX: GLN 7371

1000 AIRWAY, GLENDALE 1, CALIF.
137 Walnut Hill Village, Dallas, Texas • Fleetwood 2-5806

MACHINE TOOL DESIGNERS:

Westinghouse components and services will help you pioneer the greatest machine tool developments in history!



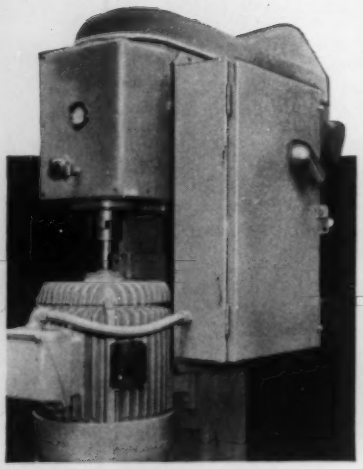
YOU CAN BE SURE... IF IT'S

Westinghouse

MP-3050-1

NEW DEVELOPMENTS FROM WESTINGHOUSE . . .

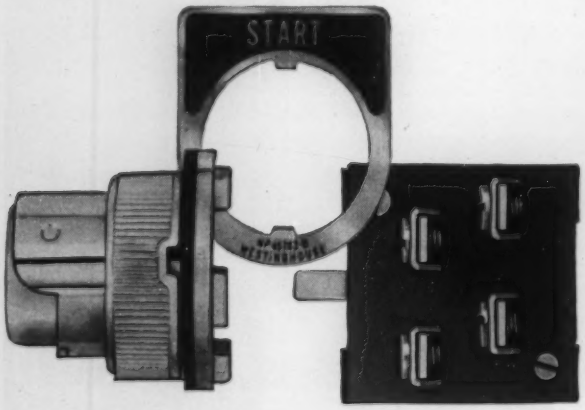
Improve drive and control functions on your new machine tools



Eighty light-load reversals per minute and no overheating . . . with Westinghouse Life-Line® "A" motors. Reliable performance under severe duty cycles lets you plan greater versatility for machine tools.

Cushioned start of connected load is assured by Westinghouse magnetic reduced-voltage starters. Add-A-Part feature provides flexibility for design and future change-over.

Cypak control has no moving parts to wear, corrode or jam. Service life is 15 times that of mechanical relays, maintenance and down time virtually eliminated. Cypak systems are compact, light, easy to modify.



Just 38 Westinghouse Oil-Tite* pushbutton components . . . standardized, interchangeable, always available from stock . . . offer up to 1,500,000 pushbutton control arrangements—cut space, inventory needs. *Trade-Mark

Westinghouse machine tool transformers take one-third less space, exceed NEMA regulation standards by 30%. Add-A-Part fuse blocks and breakers extend design selection, reduce transformer inventories.

The growing trend to faster specialized machine tools with more automatic operation makes design of compact, dependable drive and control systems for your products more vital than ever. Westinghouse has recently contributed many significant electrical developments to machinery builders that promise great strides in machine tool progress.

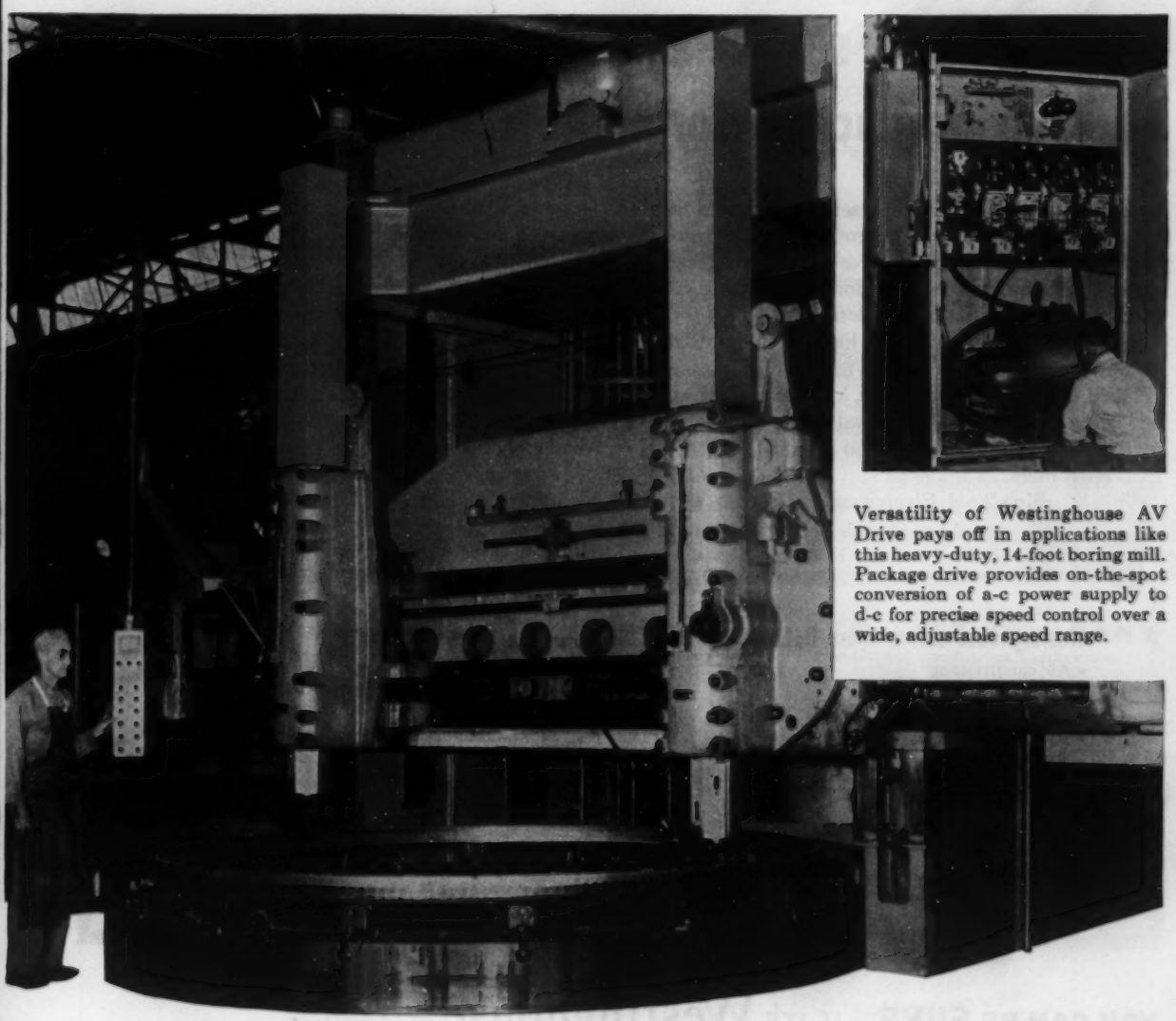
For example, there's Cypak*, a revolutionary development of Westinghouse research for reliable electrical control for machine operations, processes, and coordinated handling of materials. *It has no moving parts* to wear, corrode or jam . . . assuring long life and dependability.

Contactless limit switches, industrial electronic components unsurpassed in performance, improved-design motors, and numerous other product refinements and innovations point to Westinghouse as the electric components supplier for your machine tools.

Developments like these will help you design and build machine tools that better satisfy your customers through increased productivity, reduced inspection and maintenance, and more precise operation. Whatever the function you want performed . . . sensing, transmitting, recording, computing, control, or driving... think of Westinghouse components first.

*Trade-Mark
MP-3050-2

YOU CAN BE SURE...IF IT'S Westinghouse



Versatility of Westinghouse AV Drive pays off in applications like this heavy-duty, 14-foot boring mill. Package drive provides on-the-spot conversion of a-c power supply to d-c for precise speed control over a wide, adjustable speed range.

Westinghouse service and facilities back up product performance

Your local Westinghouse representative should be a member of your machine design team. He is trained to give you the full benefit of Westinghouse engineering and development information in analyzing your machinery electrification problems.

Westinghouse facilities are located in industrial centers from coast to coast. Westinghouse research . . . field engineering service . . . local manufacturing and repair plants . . . renewal parts stocks . . . all have been established to benefit you and your customers.

The Machine Tool Electrification Forum, sponsored annually by Westinghouse during the past 21 years, is an example of Westinghouse participation and cooperation with the machine tool industry. New ideas fostered and exchanged at such meetings help speed machine tool advances.

When you specify components, choose Westinghouse and be *sure*. You get one-supplier responsibility for products of outstanding quality, backed by more than 70 years of electrical experience. And, Westinghouse components help sell your products. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.

MP-3050-3

Westinghouse serves these O. E. M. industries

- Air conditioning
- Appliance
- Communications—electronic
- Electric apparatus
- Fan and blower
- Machine tool
- Materials handling
- Panelboard and switchboard
- Prime mover equipment
- Pump and compressor
- Miscellaneous machinery

. . . with these components

- Motors—gearmotors
- Adjustable-speed drives
- Gearing
- Controls—relays—circuit breakers
- Semiconductors
- Cypak
- Magamp* magnetic amplifiers—rectifiers
- Heating elements—thermostats
- Transformers
- Instruments
- DYNAC® magnetic braking

*Trade-Mark

YOU CAN BE SURE...IF IT'S Westinghouse

Circle 430 on page 19

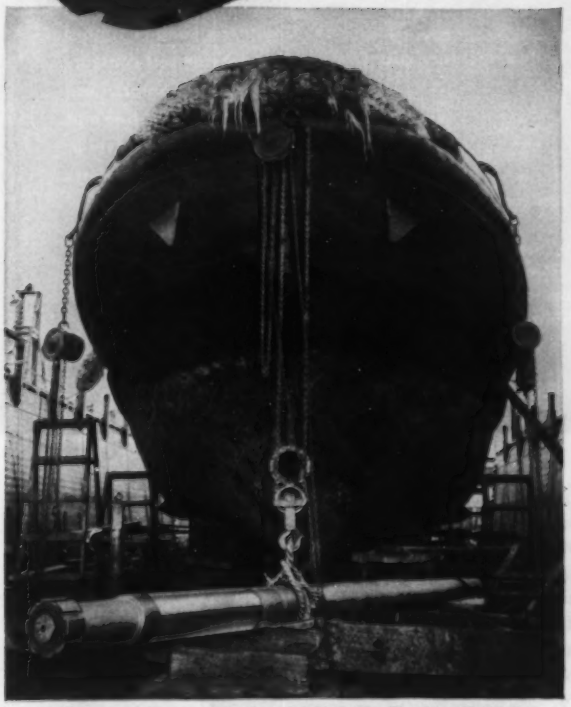
HAYNES Alloys solve *tough* wear and corrosion problems

New Method
Eliminates maintenance on bearing area of shafts

After 17 months of grueling service in the sandy salt water of New York's harbor and surrounding waters, a tail shaft sleeved with a HAYNES wrought alloy at the outer bearing area showed only 0.015 in. wear. A bronze sleeve used in this same service wore over ¼ in. in 15 months.

This remarkable improvement in wear resistance was accomplished quickly and economically by the use of half sleeves made of HAYNES STELLITE alloy. Three sets of the half sleeves protected the bearing area of the shaft.

For more information on the many industrial applications for HAYNES STELLITE alloy half sleeves and bushings, ask for a copy of our free booklet.



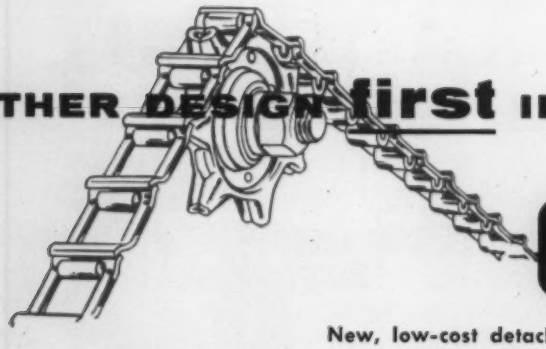
No Wear or Corrosion After 17 Months. Tug's tail shaft is removed for inspection of HAYNES STELLITE alloy sleeves at the outboard bearing area. The sleeved surface still has a mirror-like finish.

HAYNES STELLITE COMPANY
A Division of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago • Cleveland • Detroit • Houston • Los Angeles
New York • San Francisco

HAYNES TRADE-MARK ALLOYS

"Haynes" and "Haynes Stellite" are registered trade-marks of Union Carbide and Carbon Corporation

ANOTHER DESIGN first IN SPROCKET IDLERS



by

Aetna

New, low-cost detachable link chain idler combines bearing, seals and sprocket wheel in a single, compact *package* unit to give you finer performance . . . longer life . . . greater economy . . . up to 66⅔% saving in weight over solid cast steel idlers.

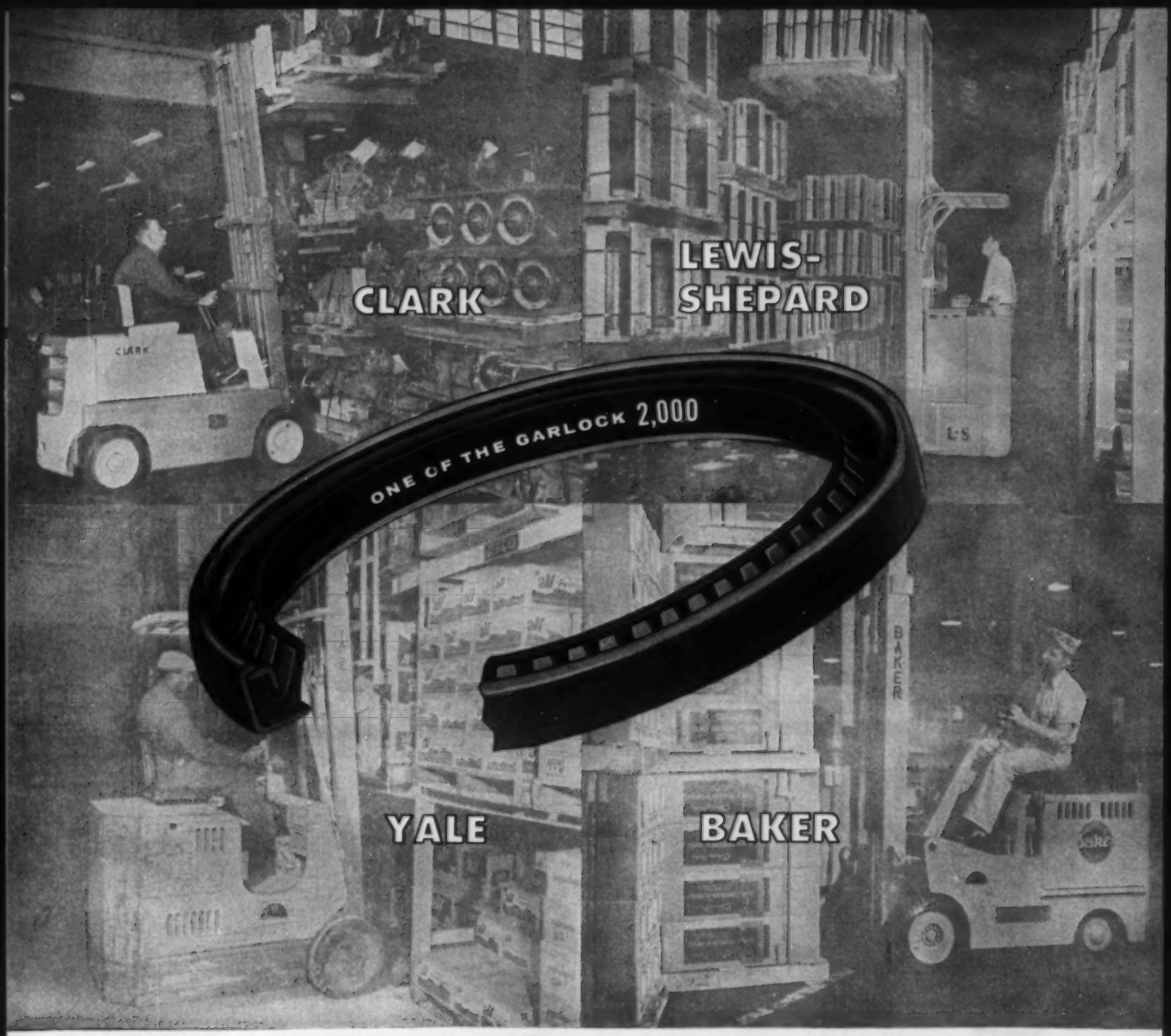
- Simple, weight-saving design. *Package* construction for easy, quick installation.
- Full complement of balls for greater capacity, 4-point ball contact for extra rigidity.
- Inner and outer bearing races case hardened for high fatigue and shock load resistance.
- Heavy gauge, case hardened steel teeth provide full contact-support area for chain cross bars.
- Large factory-packed lubricant chamber eliminates all need for relubricating.
- One-piece Buna-N rubber seals provide self-contouring positive contact; are corrosion and rust-free and exceptionally effective in excluding contaminants and retaining lubricant.
- Also available with teeth to fit standard or extended pitch roller chain.

This new detachable link chain idler is the latest addition to Aetna's growing line of sealed, pre-lubricated ball bearing *package* units which bring low-cost, anti-friction efficiency within the range of all light-duty moderate-speed equipment. All are quality built for top performance and dependability without maintenance of any kind. Write for complete data on the full line. Aetna Ball & Roller Bearing Company, Division of Parkersburg-Aetna Corporation, 4600 Schubert Avenue, Chicago 39, Illinois.

OTHER AETNA *Package* UNITS

Aetna

ANTI-FRICTION CONSULTANT TO LEADING ORIGINAL EQUIPMENT MANUFACTURERS SINCE 1916



Why Leading Lift Truck Makers Specify Garlock KLOZURE* Oil Seals

The standard sealing element in a Garlock KLOZURE Oil Seal is a unique synthetic material molded to very accurate dimensions. It is non-abrasive, free-running; oil, grease, heat, and cold resistant; impervious to water, mild acids, and alkalies. It is also extremely durable and resilient.

That's why 20 leading Lift Truck manufacturers use KLOZURE Oil Seals for sealing-in bearing lubricants, and for protecting bearings from the abrasive action of dust and dirt.

For unusual service requirements KLOZURE Oil Seals are supplied with sealing elements made of silicone rubber for temperature extremes; or Teflon to resist strong acids, and other chemicals.

If you have a sealing problem, why not ask your Garlock representative for his recommendations from "The Garlock 2,000" . . . two thousand different styles of packing, gaskets, and seals for every need. It's the only complete line. Call Garlock today, or write for KLOZURE Oil Seal Catalog No. 20.

*Registered Trade Mark

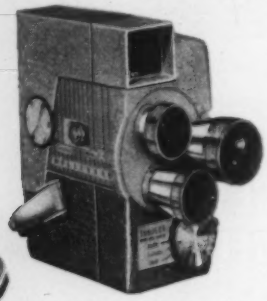
THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

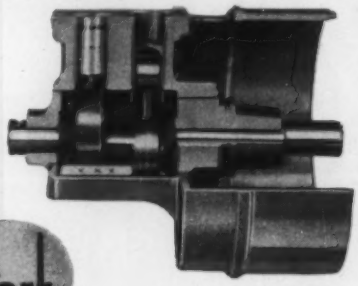
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

Circle 433 on page 19



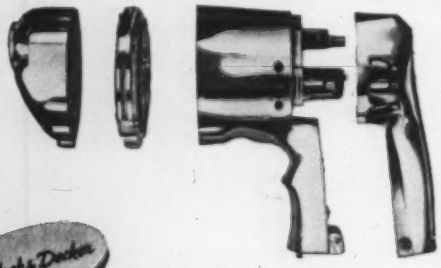
Revere

. . . makes camera parts *light-tight* and *interchangeable*



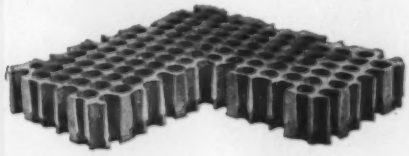
York

. . . combines motor and compressor into *one-piece* housing



Black & Decker

. . . cuts finishing of power tools to *one buffing* operation

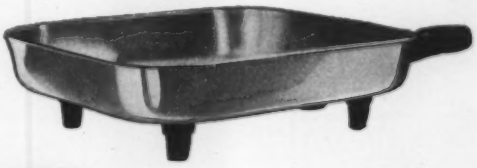


E. W. Blatchford

. . . makes "Honeycomb" printing base in *only way* it could be done

Regina

. . . concentrates *weight where needed* in floor waxer



Sunbeam

. . . closely *matches section thicknesses* to strength requirements of appliances

A dozen blue-chip products Doehler-Jarvis die-

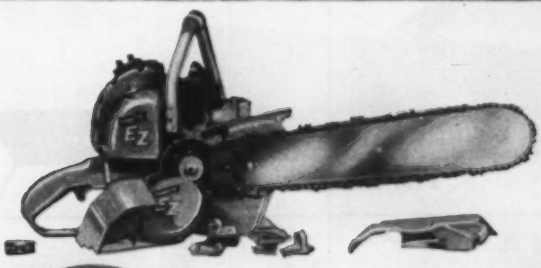
Each of these twelve products is outstanding in design.

One is extra light. Another is unique for precision. A third is remarkable for space economy. Each has a key feature that helps make it a success.

All these patterns of success are variations on a single theme . . . the skillful use of Doehler-Jarvis die castings to achieve design objectives.

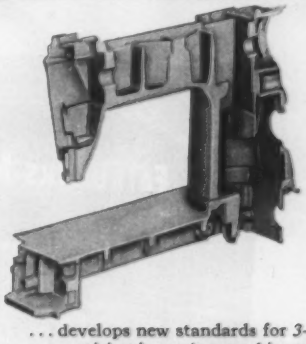
In each case, the manufacturer brought Doehler-Jarvis into the design picture at an early stage. Customer and D-J engineers worked out the specifics . . . the basic contours, the section, the coring, the ribbing, the ejection lugs, machining base points, finish . . . all the fine points.

Design results have been enviable. And frequently there have been important side benefits . . . metal saved, machining and assembly operations by-passed, finishing steps reduced, rejects prevented.



HOMELITE

... packs 5 horsepower into chain saw weighing *only 19 pounds*

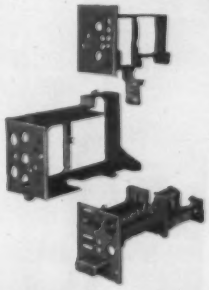


SINGER

... develops new standards for *3-dimensional* precision in sewing machine assemblies

Underwood

... replaces *six* typewriter frame castings with *one*

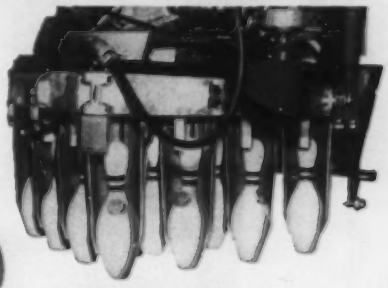


Western Electric

... makes *one* unit of space do the work of *six* in telephone terminal equipment

Sears Roebuck

... designs mower housing for *built-in assembly savings*



AMF

... *eliminates nearly all machining* in 99 pinspotter parts

illustrate a dozen ways castings improve product design

Take your cue from the makers of these successful products

If you're looking for ways to improve your product, lower its cost, or speed its production ... or if you're developing new devices ... do what the makers of the products shown above did. Call in Doehler-Jarvis.

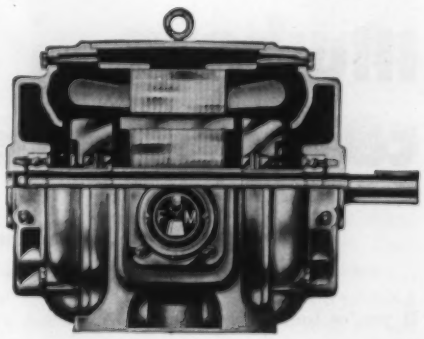
We'll be glad to help you evaluate the possibilities for you in die castings.

Doehler-Jarvis
DIVISION OF NATIONAL LEAD COMPANY
General Offices: Toledo 1, Ohio

In Canada:
Barber Die Casting Co. Limited
Hamilton, Ontario

TRADE MARK

Get the inside story...

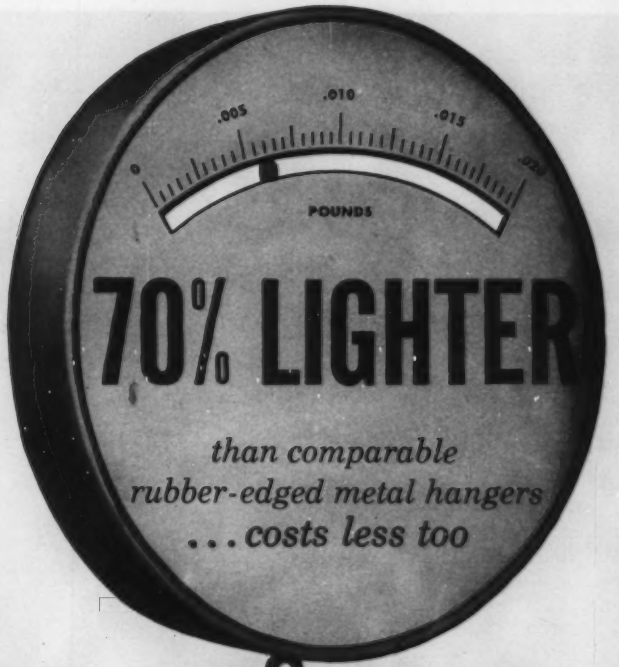


... of Fairbanks-Morse design and manufacture that set the standard of performance for motors that fulfill NEMA B, C and D requirements. Send today for Bulletin 1150 and get all the facts—including details on F-M exclusive Copperspun rotor.
Fairbanks, Morse & Co., Dept. MD-5-16, Chicago 5, Ill.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • PUMPS • SCALES • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MOWERS • MAGNETOS

Circle 435 on page 19



70% LIGHTER

than comparable rubber-edged metal hangers ...costs less too

NYLOCLIP™

NYLON CABLE HANGERS

For strong, sure support ... for sustained periods in temperature extremes from −60°F to 250°F ... these new, tough, lightweight, molded nylon cable hangers give you all the important features of metal, *plus*.

Even under severe stress, NYLOCLIP's high physical strength holds pre-formed shape indefinitely ... undamaged by oils, gasoline, alcohol, hydraulic fluids.

Self-insulating nylon is high dielectric non-conductor; eliminates hysteresis losses, grounds, shorts.

Cable insulation fully protected by rounded edges, matte finish inside surface of NYLOCLIP. Stud hole serrations running parallel to cable insure automatic alignment when screw is tightened – prevent cable chafing. Available in 17 standard sizes to accommodate cables or bundles from ⅛" to 2".

Meets MIL-STD-242 and NAVORD OSTD 600-7-3.02.29 (int.)

For proof of performance, send for samples... to your specified sizes.

rugged strength

of Nyloclip supports this man's full weight ... 247 lbs.!

BURNDY

58-10

Norwalk, Connect. • Toronto, Canada • Other Factories: New York, Calif., Toronto • Export: Philips Export Corp.

Next—pilots will watch their own landings on TV!

Up from pitch-dark airfields come light signals invisible to the human eye . . . A new electronic "cat eye" in the cockpit amplifies these signals to produce daylight pictures of the ground on the pilot's television screen.

Thus, in blackout or encased in radiation-proof cockpits, tomorrow's pilots will guide their planes in to safe landings by this latest triumph of electronics.

Like the electronic age itself, the fabulous "cat eye" depends for its operation on the very best of electrical insulations—the kind CDF has been manufacturing for over sixty years.

FOR SPECIFIC INFORMATION on CDF products, see Sweet's, Electronics Buyers' Guide, and other directories. Then send us your print or your problem, and we'll return free samples and technical literature.

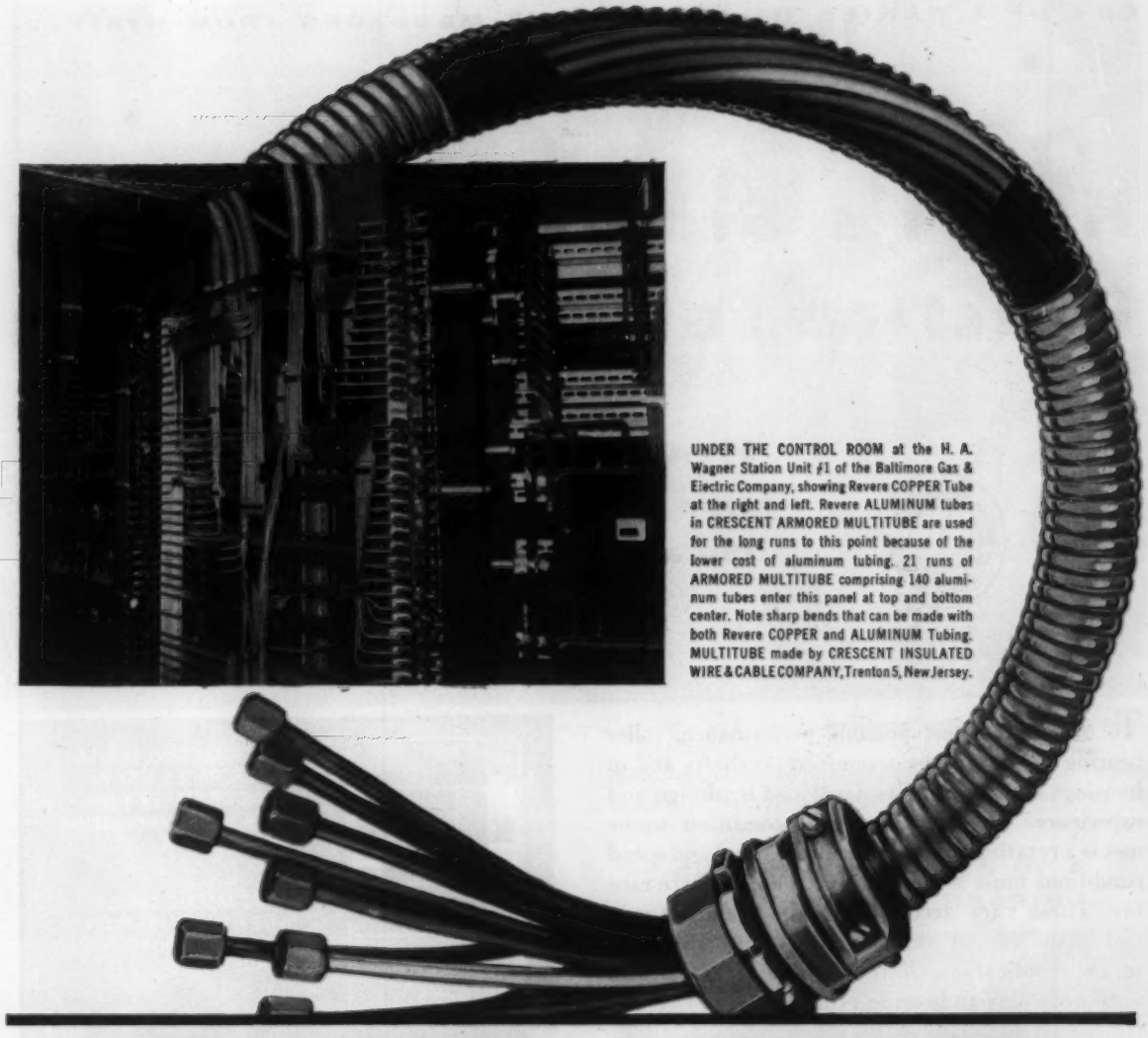
CDF MAKES Dilecto Laminated Plastics • Celoron Molded Plastics • Micabond Mica Products • Diamond Vulcanized Fibre • Flexible Tapes of Teflon*, Silicone, and Micabond • Resin-Impregnated Spiral Tubing • *Complete Fabrication Facilities.*

*duPont trademark for its tetrafluoroethylene resin

CONTINENTAL-DIAMOND FIBRE

A SUBSIDIARY OF THE BUDD COMPANY • NEWARK 23, DELAWARE

Circle 437 on page 19



UNDER THE CONTROL ROOM at the H. A. Wagner Station Unit #1 of the Baltimore Gas & Electric Company, showing Revere COPPER Tube at the right and left. Revere ALUMINUM tubes in CRESCENT ARMORED MULTITUBE are used for the long runs to this point because of the lower cost of aluminum tubing. 21 runs of ARMORED MULTITUBE comprising 140 aluminum tubes enter this panel at top and bottom center. Note sharp bends that can be made with both Revere COPPER and ALUMINUM Tubing. MULTITUBE made by CRESCENT INSULATED WIRE & CABLE COMPANY, Trenton 5, New Jersey.

CRESCENT relies on REVERE

for dependable performance of its instrumentation and control tubing

REPORTS, "NOT ONE FAILURE."

The dependable performance of Revere Copper Tube in Crescent Armored Multitube*, ever since its inception, has led the CRESCENT INSULATED WIRE & CABLE COMPANY to fill its aluminum tube needs with Revere also.

In fact, Crescent, since it first started using Revere Copper Tube in 1953, reports not a single failure. And that's mighty important in instrumentation and control tubing service where utilities, chemical processing, petroleum, paper and similar industries can't afford the luxury of process failures.

Crescent Multitube, using either Revere Copper or Aluminum Tube, or both in combination, offers a completely protected installation for permanence, lower original installation cost, lower maintenance and a saving of time, space and money.

Crescent Armored Multitube consists of a group of Revere Copper or Aluminum Tubes, twisted together in cable form, protected by a flexible interlocked galvanized steel armor. Constructions are available employing plastic sheaths in combination with the armor for corrosive locations. Section of cabled tube pictured shows how Copper or Aluminum Tubes are encased inside the Armored Multitube. As many as 37 tubes of ¼" OD can be cabled in lengths up to 1,000 ft.

For details on Multitube write Crescent and for uniform quality copper and aluminum tube, speedily delivered, see the nearest Revere Sales Office.

*Reg. Trademark

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities, Distributors Everywhere.

COPPER * BRASS * REVERE * ALUMINUM

Circle 438 on page 19

Hyatt's Simplified Fitting Practice for Bearing Races

HYATT pioneered the use of carburizing type alloys in order to obtain the advantages of heavier race fits

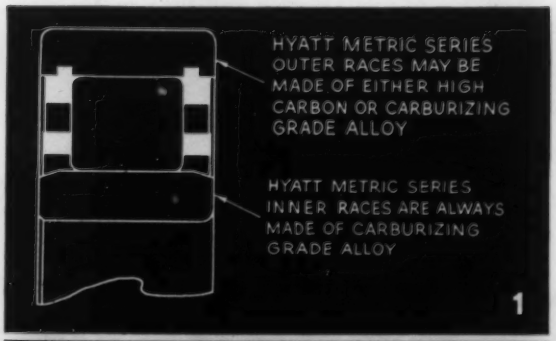
To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with certain fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size.

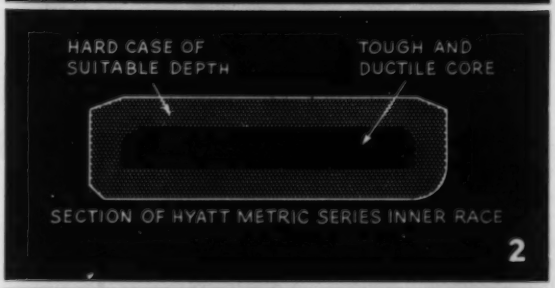
1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS

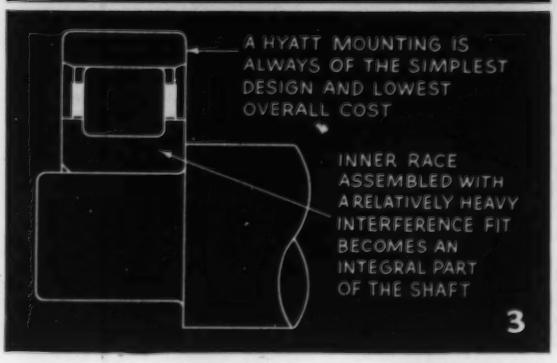
Taking the standard metric series of cylindrical roller bearings for an example, the bearing user has the choice of two fitting practices. One involves the use of inner races made of through-hardening steel, which dictates fairly light interference fits to avoid splitting. The other utilizes races made of low carbon steel *carburized* and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and has the additional advantage of eliminating all auxiliary holding devices, because the race becomes practically an integral part of the shaft. (Figs. 1, 2.)

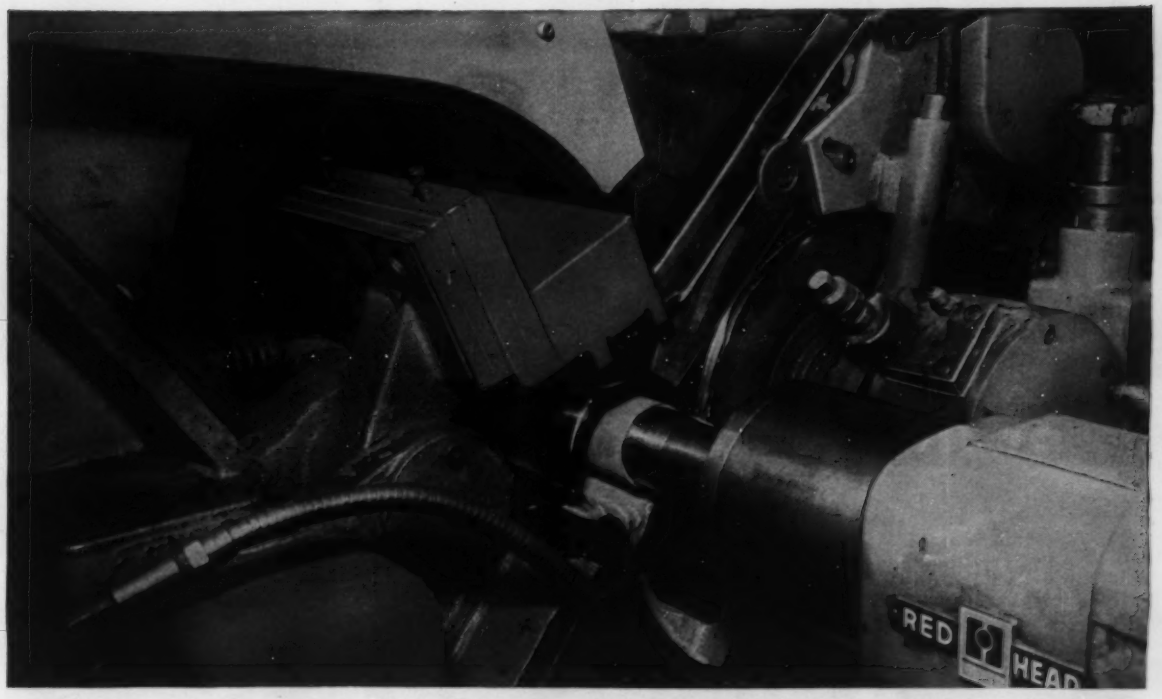
2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS

Hyatt originated the carburized race and the system of relatively heavy inner race fits to simplify bearing mounting and eliminate the need for retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit mountings of the simplest type and lowest over-all cost. Furthermore, the shoulders of HYATT carburized races will withstand considerably greater impact loads than will ordinary races. (Figures 3 and 4.)


HYATT METRIC SERIES OUTER RACES MAY BE MADE OF EITHER HIGH CARBON OR CARBURIZING GRADE ALLOY
HYATT METRIC SERIES INNER RACES ARE ALWAYS MADE OF CARBURIZING GRADE ALLOY
1




A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT
3

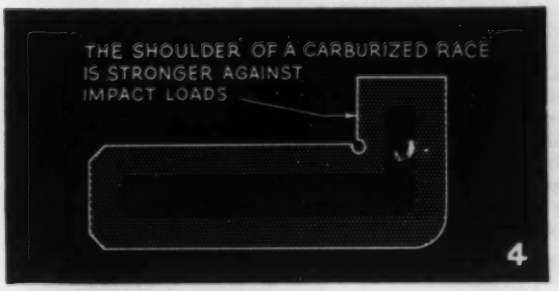


Hyatt inner race being centerless I. D. (inside diameter) ground to close tolerances.

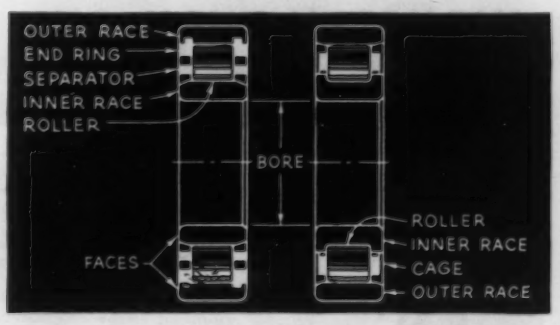
There are two fitting specifications which apply to HYATT inner races, depending on whether the inner race rotates or is stationary in operation. Remember, with both inner and outer race, the rotating member is assembled with heavier fit.

3. HYATT INNER RACES CAN BE EASILY SHRUNK ON SHAFTS

HYATT inner races may be mounted on shafts by pressing or shrinking. Where shrinking practice is employed, first heat the race in oil held at a temperature not over 300°F, or in an electric oven under a similarly controlled temperature, until it expands sufficiently to be slipped into position. The required interference fit will develop as the race cools in place. For special conditions of fit involving hollow shafts of varying sections or multiple housings of dissimilar metals, consult your HYATT Sales Engineer from our nearest sales office.



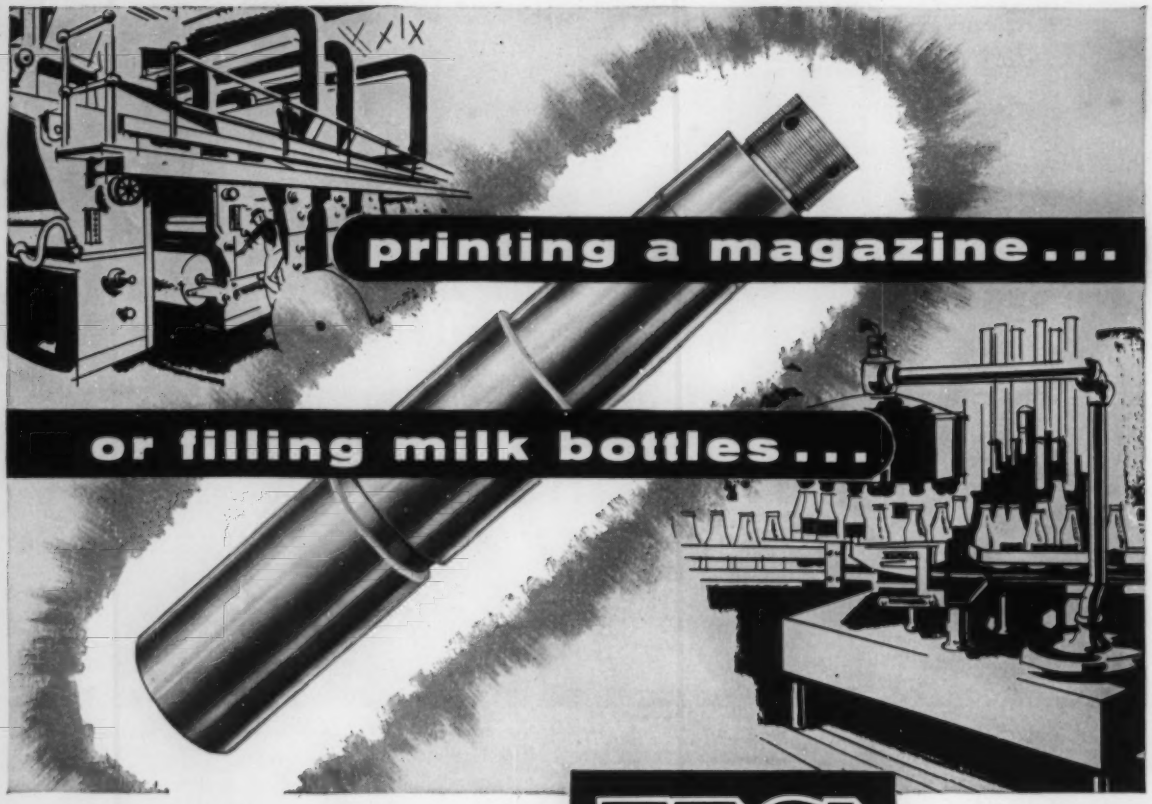
COMPONENT PARTS OF A HYATT ROLLER BEARING



YOU WILL FIND MORE DETAILS in HYATT Catalog No. 150. If you do not have a copy, write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey. Sales offices at Harrison, Pittsburgh, Chicago, Detroit and Oakland, California.

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

GM GENERAL MOTORS



THE WHEELS OF INDUSTRY TURN ON US AXLE SHAFTS

Out in the field and inside the plant, wherever there's work to be done, you'll find labor-saving and time-saving machines. And wherever you find machines, you'll find U.S. Axle Shafts in every size and description, making their contribution toward smooth, trouble-free performance.

U.S. Axle Shafts are made of the finest alloy steel, heat-treated, and then shot-peened — the hardening process that makes U.S. Axles up to 5 times tougher —by actual torsion tests. We will be happy to use our 36 years of engineering skills to help you improve *your* product performance.

Call on U.S. AXLE for shafts for every application

FREE VALUABLE BROCHURE

Shows you why U.S. Axle is your best source for precision-made special shafts.

THE U. S. AXLE COMPANY
Pottstown, Penna.

Please send me the brochure on "U.S. Custom-Engineered Shafts."

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"THE WORLD TURNS ON U. S. AXLES"

THE US AXLE COMPANY, INC.
Since 1920 • Pottstown, Pennsylvania

OILITE
IN AN AUTOMATIC WASHER HELPS BUILD CUSTOMER SATISFACTION -YET COSTS NO MORE
OILITE bronze agitator shaft bearing
OILITE bronze upper center post bearing
OILITE bronze rubber-mounted lower center post bearing
OILITE bronze thrust washers (2)
OILITE bronze pulley bearing
OILITE bronze thrust bearing
OILITE bronze water pump bearing
Photos courtesy Whirlpool-Seeger Corporation St. Joseph, Michigan
Another cost-saving application of Amplex Powder Metallurgy

Quality is a *must* for trouble free operation, continued customer satisfaction. And quality depends upon the excellence of every part, every component. For many years Whirlpool-Seeger has used OILITE center post bearings, agitator shaft bearings, water pump bearings and pulley bearings in their automatic washers. Whirlpool-Seeger uses these and other OILITE parts for very good reasons.

First of all, the manufacturer knows OILITE heavy-duty bronze bearings will meet specifications. Chrysler-Amplex precision production assures him OILITE bearings capable of carrying their loads safely, surely and quietly.

Then too, Chrysler-Amplex plant and facilities—largest and most complete of any in the metal powder fabrication industry—promises on-time deliveries in any quantity.

Moreover, in using OILITE bearings the manufacturer selects a product his customers know and respect for superior engineering.

Finally, this manufacturer, like a great many others, finds OILITE bearings—despite all their advantages—cost no more.

Chrysler-Amplex representatives and dealers are located in principal cities in United States and Canada. Let the nearby representative help you. Find him in the yellow section of your telephone directory under—"Bearings—OILITE."

A CHRYSLER OILITE PRODUCT

*OILITE is a registered trademark

*Only Chrysler Makes Oilite**

AMPLEX DIVISION

CHRYSLER CORPORATION • DETROIT 31, MICHIGAN

Representatives and dealers located throughout the world

BEARINGS • FINISHED MACHINED PARTS • PERMANENT METAL FILTERS • FRICTION UNITS • FERROUS AND NON-FERROUS METALS

Circle 441 on page 19

AT THE DESIGN ENGINEERING SHOW!

WIN A PRIZE AT THE

VISIT THE USS "T-1" STEEL EXHIBIT

You not only will gain useful information about the most exciting new alloy steel in a decade—USS "T-1" Constructional Alloy Steel—you also will have an opportunity to win useful and valuable prizes.

T_1

At the exhibit, two flame-cut pieces of "T-1" Steel plate will be on display—one in the shape of a "T" and the other in the shape of a "1." All you have to do is guess their weight. Prizes will be given for the closest answers.

T_1

You'll find the contest fun . . . and the new information on application and fabrication of this versatile steel interesting and profitable! So be sure to stop at the United States Steel Exhibit.

U. S. STEEL EXHIBIT

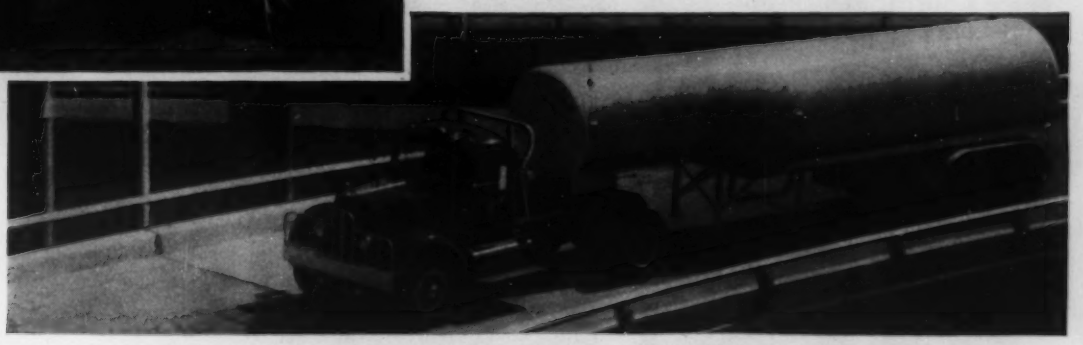
...Learn how USS "T-1" Steel can improve products like these:

HIGH-VOLUME TRAILER WEIGHS LESS, OPERATES FASTER.

USS "T-1" Steel enables Athey Products Corporation, Chicago, Illinois, to achieve a new low ratio of vehicle weight to load weight in rear-dump trailers like this. Built especially for hauling lightweight materials, this trailer weighs 7,000 pounds less than conventional units . . . travels faster . . . and can carry 8 yards more payload.

PAYLOAD OF LPG TANK TRUCK INCREASED 500 GALLONS!

The high yield strength of "T-1" Steel enabled designers to raise working stress from the usual 21,250 psi to 26,650 psi (now permitted by Case 1204 of The ASME Boiler Code). As a result, shell thickness and weight were reduced 20% without sacrificing strength or safety. The "T-1" Steel tank carries 7,750 gallons at a working pressure of 250 psi.



UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

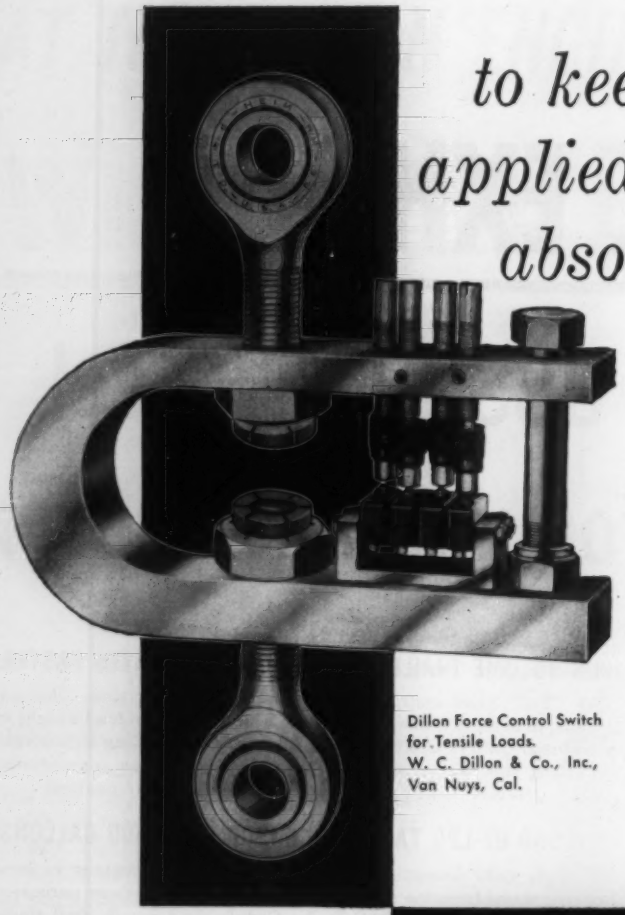
USS "T-1" CONSTRUCTIONAL ALLOY STEEL

"USS" and "T-1" are registered trademarks

Watch the **United States Steel Hour** on TV every other Wednesday (10 p.m. Eastern time).

UNITED STATES STEEL

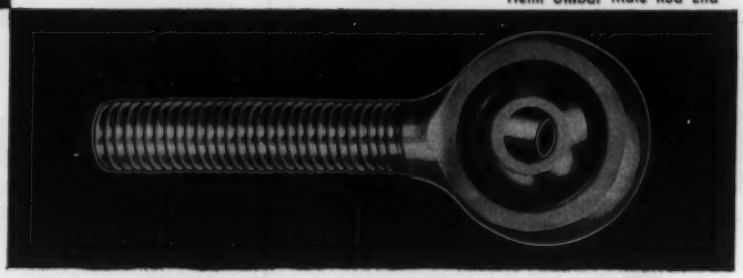
to keep the applied line of force absolutely vertical



Dillon Force Control Switch for Tensile Loads. W. C. Dillon & Co., Inc., Van Nuys, Cal.

It is essential that applied line of force remain absolutely vertical in the popular Dillon Force Control Switch, and the best possible solution has been found in the HEIM Unibal Rod End Connector. Two of these are employed so that regardless of load angle, the actual instrument always remains straight up and down. Heim Unibal also allows the operator to adjust working length to suit available space. Dillon engineers rate them tops for critical fit, freedom from slop or wobble and for all-around quality.

Heim Unibal Male Rod End



What does the Dillon Force Control Switch do?

As many as four control switches may be mounted on one side of the open end. Directly opposite, and on the other side of the beam, are finely threaded adjustment screws, which make contact, under load, with each switch in succession or with all at the same instant. Thus, if it is necessary to trigger a series of devices at varying loads, each switch is set at the specific load. If all four devices are to be triggered at the same time, then all four switches are identically adjusted.

The Dillon Switch affords excellent overload protection for hoists and cranes, operates remote signal lamps, warning devices, etc.

The **HEIM** *Unibal* is the spherical bearing developed, engineered and manufactured by The Heim Company for over fifteen years. They correct misalignment in every direction, reduce friction, carry maximum radial and thrust loads, save time in assembling, and are usually more economical than specially machined parts.

Heim Unibal Bearings are distributed nationally by qualified bearing experts. Send for the Heim Complete Catalog.

THE HEIM COMPANY / Fairfield, Connecticut

Circle 443 on page 19

A PROBLEM
IN HYDRAULIC
CONTROL?

call the man from Webster

On America's leading tractors, Webster Hydraulic pumps have proven themselves a winner. They stand up better to such tough, demanding day after day abuse. When your hydraulic application calls for proven stamina to resist shock, with a reserve of quick response and compactness of overall design . . . be it for farm equipment or power shovels, then the man from Webster can help. Let him tell you about the complete Webster line of over 100 different positive displacement gear type pumps and fluid motors.

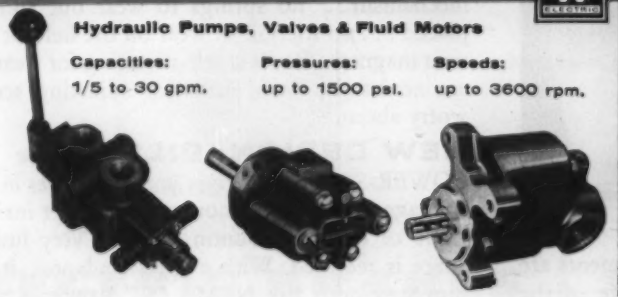
Write or call the man from Webster — a good man to have on your design team.

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC
MELROSE 3-3511
RACINE · WIS

Hydraulic Pumps, Valves & Fluid Motors

Capacities:	Pressures:	Speeds:
1/5 to 30 gpm.	up to 1500 psi.	up to 3600 rpm.



FRANKLIN ADV. H102

☐ *Have THE MAN FROM WEBSTER contact us—*

- Please send the following -

☐ *Complete hydraulic catalog of pumps and valves*

☐ *New information or data as published*

Name _____
Title _____
Company _____
Street _____
City _____ State _____

IT'S A FAIL-SAFE BRAKE!
IT'S A NEW TYPE OF POWER BRAKE!...IT'S

2 electric brakes in 1

for the overhead jobs!

NEW VERSATILITY—It's designed for use as a power brake or a fail-safe brake on overhead cranes, shears, and similar applications. Has all the speed, high torque, and controllability of other Warner electric brakes . . . plus full-time reserve braking power supplied by permanent magnets.

Fail-safe feature consists of powerful permanent magnets, which keep the replaceable facing and armature positively engaged except when the field is energized. Energizing the field diverts the permanent magnet flux through an auxiliary circuit. Then, the brake releases and will stay released until the field is de-energized.

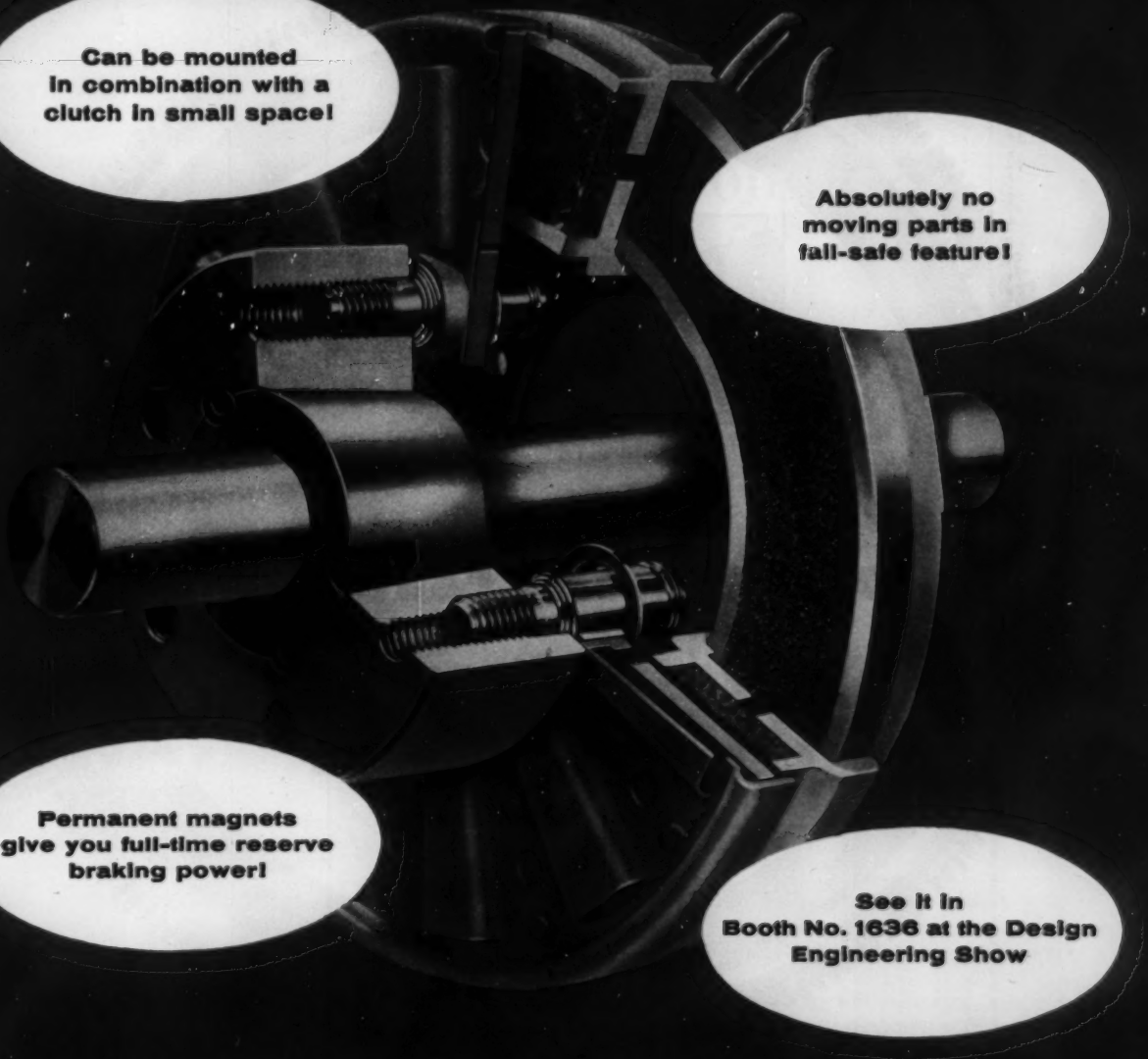
For power braking, you reverse the current in the coil so the flux concentrates in a path through the armature, replaceable face, and field coil, supplementing the flux of the permanent magnets. It's that simple!

NEW ADJUSTABILITY—Unlike most "off-on" brakes, the torque build-up in Warner's new POWER-SAFE brakes can be electrically adjusted over most of its range. Torque is smooth-acting. There's no shock when the permanent magnets actuate the fail-safe brake.

NEW SIMPLICITY—There are only three main parts: stationary field, replaceable face, and armature. There are no moving parts in the fail-safe mechanism . . . no springs to wear out and be replaced . . . no friction or wear on the field or permanent magnets. Brake is self-adjusting for wear. There are no bands, links, cams, or adjusting screws to worry about.

NEW DESIGNABILITY—The Warner POWER-SAFE brake gives you big power in a small package. It's easy to mount, with either inside bolt circle or outside mounting flange. Very little axial space is required. With a special adapter, it can be mounted onto any NEMA "C" flange as a motor brake. Used in combination with a clutch, you get fast stop-start control. Four sizes now available . . . with "power" torque ratings from 125 to 650 lb ft, and fail-safe ratings from 33 to 205 lb ft.

NEW DEPENDABILITY—No adjustments are necessary to maintain constant torque for the life of the POWER-SAFE brake. There's no "fade" as engagement surfaces wear. There are no springs to fatigue or change pressure when other parts start to wear. You have reserve braking power at all times to guard against electrical failure.


Can be mounted in combination with a clutch in small space!
Absolutely no moving parts in fail-safe feature!
Permanent magnets give you full-time reserve braking power!
See it in Booth No. 1636 at the Design Engineering Show

IT'S WARNER'S NEW "POWER-SAFE" ELECTRIC BRAKE

Beat competition with

ELECTRIC BRAKES AND CLUTCHES

Circle 445 on page 19

SEND for your copies of this free new booklet!

Industrial Division, Dept. MD
Warner Electric Brake & Clutch Co.
Beloit, Wisconsin

☐ Please send bulletin describing POWER-SAFE electric brakes.
☐ Please have representative call.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

Tapered for positive suspension.
High radial sealing surface.
"Tongue and groove" for easy installation.
Clearance for radial motion.

KOPPERS HUHN CARBON RING

Reduces Steam Loss as much as 90%!

The unique design of Koppers Huhn Carbon Ring reduces steam loss far below the customary 1% loss of labyrinths and carbon garter spring rings. Huhn Carbon Ring keeps steam loss as low as ¼ of 1% . . . often as little as 1/10 of 1%. Using your own figures for steam costs, you can easily discover how much Koppers Huhn Carbon Rings can save you annually.

The design assures you continuous radial sealing . . . because a radial sealing surface is always forced against a chamber wall. Automatic suspension . . . even during shutdowns . . . prevents shaft contact, reduces wear, and prolongs life. The Huhn Carbon Ring operates with peak efficiency at highest shaft surface speeds and highest operating temperatures.

Koppers Huhn Carbon Ring replaces labyrinths and carbon garter spring rings in compressors, and steam and water turbines. Steam savings alone often pay within a year for the cost of replacement. Discover now how Huhn Carbon Rings reduce steam and fluid losses and minimize operating, maintenance and repair costs. Write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 2305 Hamburg St., Baltimore 3, Md.

Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS®

MECHANICAL SHAFT SEALS

Circle 446 on page 19

You don't have to shop around . . .

A-L Stainless Steel is produced in every form you may need

You ought to have a copy of our PUBLICATION LIST

This 8-page bulletin lists and describes all the current publications on the principal families of A-L Products: stainless and heat-resisting steels, tool and die steels, electrical steels and alloys, permanent magnet materials, and Carmet carbides. There is a handy order form for your convenience in getting the material you need: technical and fabricating data, information on applications and fields of utility, etc. *Write for your copy.*

ADDRESS DEPT. MD-89

WHATEVER your stainless steel requirements may be, you can satisfy them with A-L Stainless.

It's produced in any grade, form or finish you want—from the finest wire to heavy plates, castings and forgings, including sheets, strip, bars, shapes, tubes —*everything!*

That's not only handy, but advantageous: one reliable source, one undivided responsibility, one well-known standard of quality and uniformity.

Complete technical and fabricating data —engineering help, too—are yours for the asking. Just keep it in mind to specify "A-L Stainless Steel" when you're in the market. And remember, wherever you use it, this time-tested stainless steel looks better, lasts longer, usually works out to cost you very much less in the long run. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

For Stainless Steel in ALL Forms—call

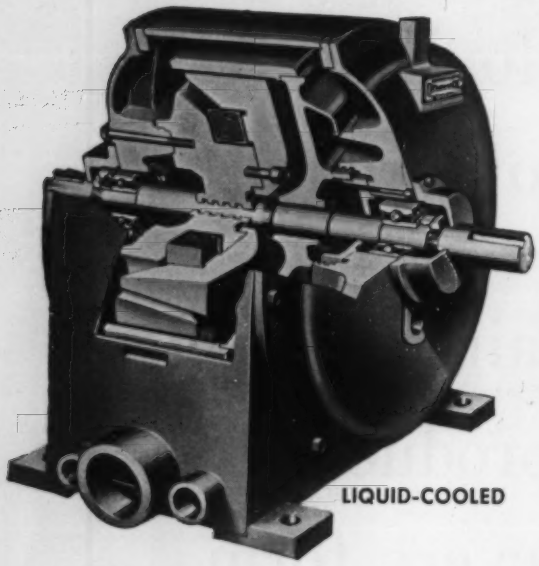
Allegheny Ludlum

AL STAINLESS STEEL

Warehouse stocks carried by all Ryerson Steel plants

Circle 447 on page 19

There are Hundreds of Uses for



LIQUID-COOLED

DYNAMATIC®

EDDY-CURRENT BRAKES

Wide range of torque capacities and operating speeds. Smooth, frictionless, shock-free operation. No rotating electrical components or contacts. Electronic or magnetic amplifier control from AC power.

Here Are Some Suggestions

Providing constant tension or constant linear feet per minute speed for unwind stands in metals, fabric, plastic, and paper industries.

AIR-COOLED

For accurately controlling lifting and lowering functions of cranes and hoists by creating an opposed load on a wound rotor motor.

Providing a controlled load for the production testing of engines, transmissions, or axles.

Smooth stopping of high inertia masses; precise control of deceleration with automatic or manual controls.

For Complete Information
Send for Your Copy of Our New Illustrated Bulletin No. BR-1

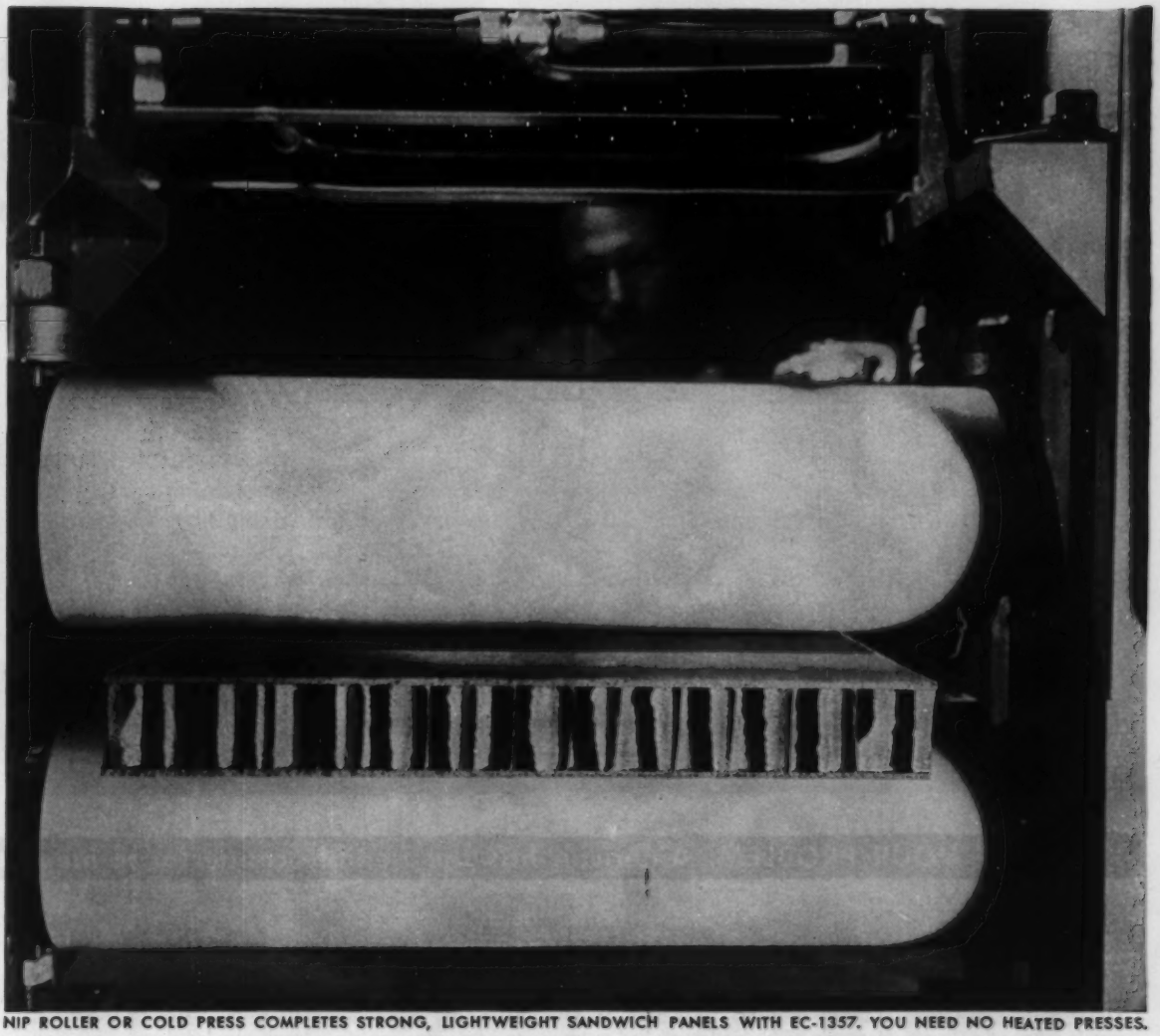
EATON®

EATON

DYNAMATIC DIVISION
MANUFACTURING COMPANY
3307 Fourteenth Ave. • Kenosha, Wisconsin
General Offices: Cleveland, Ohio

Circle 448 on page 19

For fast, cold sandwich bonding ...3M Adhesive EC-1357



NIP ROLLER OR COLD PRESS COMPLETES STRONG, LIGHTWEIGHT SANDWICH PANELS WITH EC-1357. YOU NEED NO HEATED PRESSES.

Gain the speed and economy of cold bonding! Fabricate sandwich panels for non-load bearing uses with 3M Adhesive EC-1357.

This high-strength, flexible adhesive bonds sandwich panels without clamps or heated presses. You force-dry the solvent out of the adhesive before bonding. Cold press or nip roller finishes the job. You get maximum immediate strength. And EC-1357 builds up even more strength with age as it cures at room temperatures.

Because it is dark in color, EC-1357 absorbs drying heat fast. Thus it cuts production time, allows continuous movement from adhesive spraying to finished panel. EC-1357 resists moisture and normal temperatures, too. For load-bearing panels, investigate 3M Adhesive EC-1177.

SEE WHAT 3M ADHESIVES CAN DO FOR YOU!

Consult 3M research. Contact your 3M Field Engineer. Or for information and free literature, write on your company letterhead to:3M,Dept. 105, 417 Piquette Ave., Detroit 2, Mich.

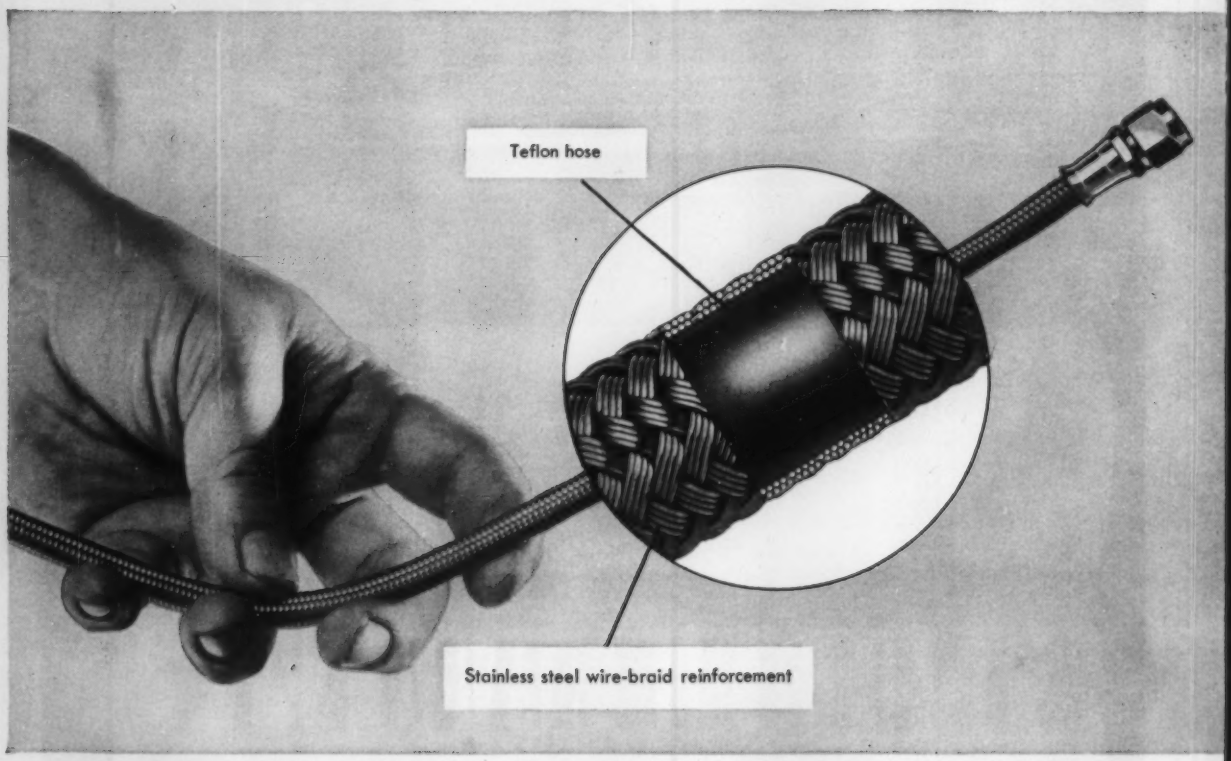
PRODUCT OF 3M COMPANY RESEARCH

MINNESOTA MINING AND MANUFACTURING COMPANY • ADHESIVES AND COATINGS DIVISION

417 PIQUETTE AVE., DETROIT 2, MICH. • GENERAL SALES OFFICES: ST. PAUL 6, MINN. • EXPORT: 99 PARK AVE., N.Y. 16, N.Y. • CANADA: P.O. BOX 757, LONDON, ONT.

NOW! A Tough Material To

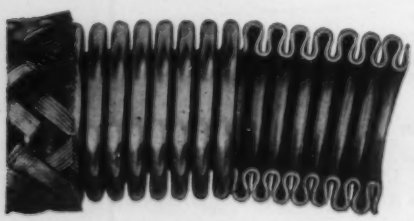
Introducing AMERICAN FLEXIBLE



NAME YOUR PROBLEM. American has the flexible connector to meet it.

AMERICAN SEAMLESS

Easily installed, low-maintenance, long-life tubing of bronze, carbon steel, stainless steel, Monel, cupro nickel, brass and other workable metals solve most flexible connector problems involving steam, oil, liquids, gases, etc., under pressure; for absorbing vibration in rigid pipelines, connecting misaligned ports; for piping in limited space and service where there is intermittent or continuous flexing.



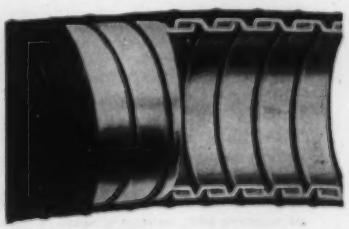
AMERICAN STRIPWOUND

Combines all-metal strength with extreme flexibility, permitting easy installation and handling. Made in bronze for conveying steam and water, in steel for conveying oil, tar, asphalt, etc., and in copper, aluminum, carbon steel, stainless steel, and other metals for special applications. With or without wire braiding.

AMERICAN SEALTITE†

Flexible, liquid-tight conduit. Protective raceway for electrical wiring, made of a flexible galvanized steel core with tough extruded plastic jacket. Completely liquid-tight, resists chemicals. Absorbs movement, vibration, simplifies installation in tight spaces or where there is offset.

†Trademark



Meet Tough New PROBLEMS
TEFLON HOSE

Heat-resistant, corrosion-proof, lightweight Teflon* flexible hose absorbs vibration, takes up movement, simplifies offset connections and installations in cramped spaces

FOR AIRCRAFT, GUIDED MISSILES AND ATOMIC ENERGY FIELDS. American Flexible Teflon Hose offers the double advantage of economy and longer life in many applications: fuel lines, oil lines, oxygen lines, hydraulic lines and others.

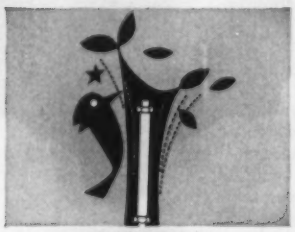
Properties include complete tightness under high pressures, high resistance to fatigue, torsion and corrosion, light weight and capability of continuous service in temperatue range of—100°F. to 500°F. Unaffected by any known type of fuel, oil, or acid within the temperature range of the hose.

FOR TOUGH INDUSTRIAL JOBS. American Flexible Teflon Hose promises long, economical service in many industrial applications. It is ideal where lines are subjected to outdoor exposure or attack by chemicals, or where high temperatures are a factor—either in the material being conveyed or plant surroundings.

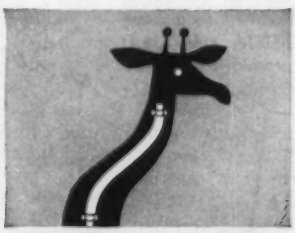
HOW CAN YOU USE AMERICAN FLEXIBLE TEFLON HOSE TO REDUCE COSTS OR IMPROVE PRODUCT SERVICE? American Metal Hose engineers will be glad to consult with your engineers. Write for bulletin TF-100, or call: The American Brass Company, American Metal Hose Division, Waterbury 20, Connecticut. In Canada: The Canadian Fairbanks-Morse Company, Ltd.

*DuPont trademark for its tetrafluoroethylene resin

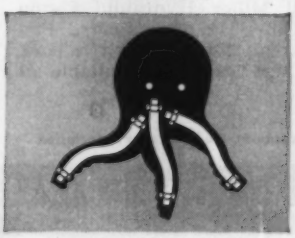
Contact American to solve problems of . . .



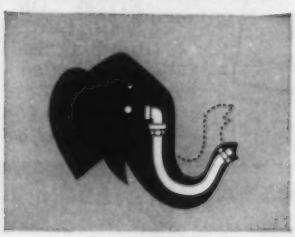
VIBRATION



OFFSET CONNECTIONS



CRAMPED SPACES



MOVEMENT

WHEREVER CONNECTORS MUST MOVE

AMERICAN

FLEXIBLE METAL AND TEFLON HOSE AND TUBING

AN

ANACONDA®

PRODUCT

Guarantee **TOP** Performance and Maximum Life!

Specify THESE TOP QUALITY FEATURES...

(Standard on Miller Cylinders at no extra cost)

Specify CASE HARDENED CHROME PLATED PISTON RODS On all Air and Hydraulic Cylinders

Benefits To You

CASE-HARDENED Piston Rods (52-54 Rockwell "C") provide practically complete protection against damage from hammer blows, wrench-dropping, mishandling, and similar occurrences. *Available from Miller at no extra cost.*

The HARD CHROME PLATING over the case-hardened rods protects against scratch-damage and rust. *Available from Miller at no extra cost.*

Specify "TEFLON" WIPERS On all Air and Hydraulic Cylinders

Specify "TEFLON" HYDRAULIC ROD SEALS On all Hydraulic Cylinders

Benefits To You

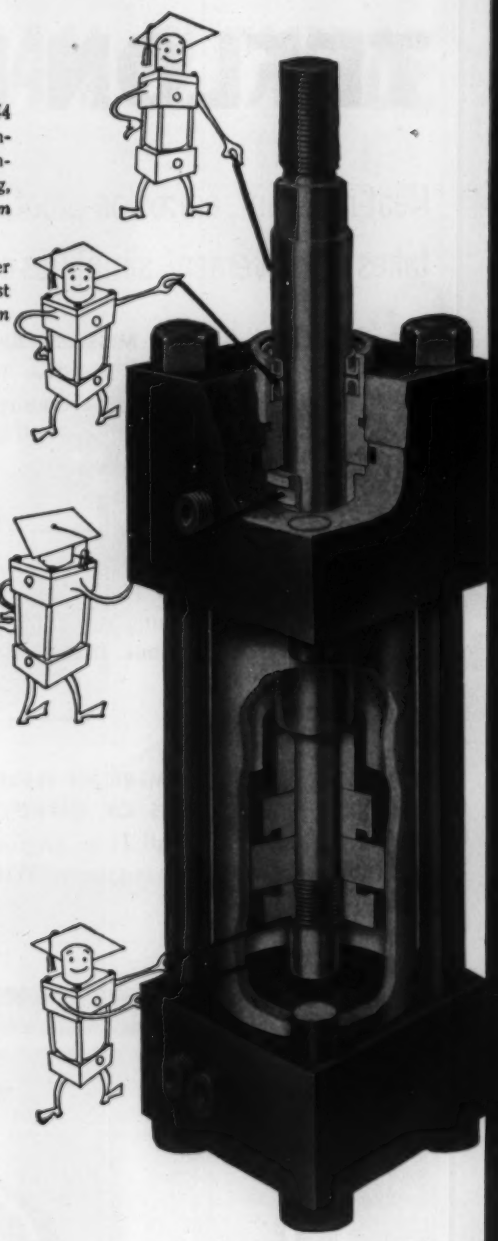
"TEFLON" Rod Wipers and "TEFLON" Hydraulic Piston Rod Seals withstand temperatures from—100°F. to plus 500°F. They are impervious to practically all known chemicals, including the fire-resistant, special, and standard hydraulic fluids in current use. *Available from Miller at no extra cost.*

Specify RUST RESISTANT SURFACES On all Air and Hydraulic Cylinders

Benefits To You

Highest quality Black Ferric Oxide Finish provides rust protection in air cylinder operation and on all cylinders during shipping and installation.

Cylinder heads, caps, mountings, pistons, followers, tie rods, and the unplated portions of the piston rods have this finish *at no extra cost on all Miller cylinders.* (This finish not recommended for water service)



You may wish to route this entire page to the proper department in your company, by using this handy form. Additional copies on request. →

To (Dept.)_____

"On all our future cylinder requirements, please specify the above quality features."

Signed_____

Title_____

NOTE. On all Miller Hydraulic Piston Seals: Leather Cup Seals are *standard*, Piston Ring Seals are optional *at no extra cost*, and "Teflon" Cup Seals are available *at extra cost.*

Member of the National Fluid Power Association

SALES AND SERVICE FROM COAST TO COAST

CLEVELAND • YOUNGSTOWN • DAYTON • TOLEDO • CINCINNATI • COLUMBUS
PITTSBURGH • PHILADELPHIA • BOSTON • HARTFORD • NEW YORK CITY
BUFFALO • ROCHESTER • MINNEAPOLIS • GRAND RAPIDS • DETROIT • FLINT
FORT WAYNE • SOUTH BEND • INDIANAPOLIS • MILWAUKEE • LOUISVILLE
KANSAS CITY • SEATTLE • LOS ANGELES • SAN FRANCISCO • BALTIMORE
DENVER • ST. LOUIS • MOLINE • CHICAGO • HOUSTON • ATLANTA
TORONTO, CANADA and OTHER AREAS

Circle 451 on page 19

MILLER FLUID POWER DIVISION FLICK-REEDY COR

2006 N. Hawthorne Ave., Melrose Park, Ill.

AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATO
COUNTERBALANCE CYLINDERS

How's this for corrosion control?

Carpenter Stainless No. 20 pickling rack still in H_2SO_4 service after 5½ years!

Steady exposure to 5-15% sulphuric acid at temperatures up to 200°F for over 5½ years is the service record of this pickling rack made from Carpenter Stainless No. 20. It supports heavy loads of pole line hardware during pickling. Dependable corrosion resistance in the steel is invaluable.

Ordinary steels lasted but a short time on this application. Then, Carpenter Stainless No. 20 was put to work. The result is added safety for the workers, substantial savings in replacements, and uninterrupted production.

Today industry is finding a host of uses for this super corrosion-resisting steel. A wide variety of products of No. 20 can be purchased already fabricated . . . or you can build your own. In addition to hot sulphuric acid, this unique steel resists attack by a long list of other corrosives.

Whatever your corrosive application, talk to Carpenter first about the cost-saving advantages of No. 20. Over 70 years' experience in the development and manufacture of specialty steels are at your service when you contact your nearest Carpenter Mill-Branch Warehouse, Office or Distributor.

Partial list of Stainless No. 20 products now being fabricated:

- Agitating equipment
- Baskets
- Centrifugal pumps and parts
- Coils
  - Heating and cooling
- Dehydrators
- Exchangers, Heat
- Fans
- Fastenings (all types of standard and special design)
- Fittings
- Grommets
- Hangers
- Instruments
  - Heat and temperature
  - Industrial liquid level
- Mixers
- Nozzles
- Pails for sulphuric acid
- Pipe
- Processing equipment (food and chemical industry)
- Pump parts
- Screws
- Tanks, welded
- Thermocouple wells
- Tube
- Valve parts
- Valves
- Vessels, welded
- Weld rods
- Wire
  - Baskets
  - Cloth
  - Stranded
- And others

Carpenter Stainless No. 20-Cb is available from The Carpenter Steel Company, Alloy Tube Division, Union, New Jersey, in the forms of tubing, sheet, strip, pipe and plate; and Stainless No. 20 in the forms of bars, billets and wire.

Our new leaflet "*Positive Protection*" has a more complete list of available products made from No. 20. If you haven't a copy, please drop us a line.

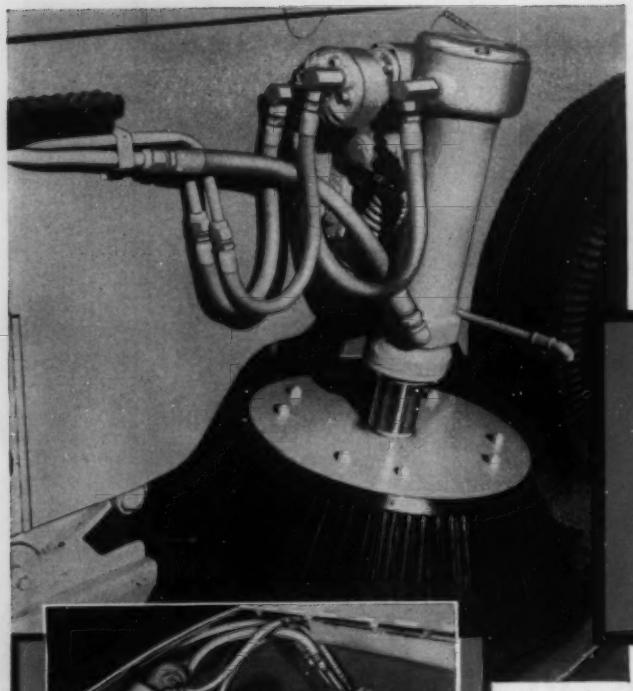
Carpenter STEEL

Super Corrosion-Resistant Stainless

Pioneering in Improved Tool, Alloy and Stainless Steels Through Continuing Research

The Carpenter Steel Co., 120 W. Bern St., Reading, Pa.
Export Department: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"

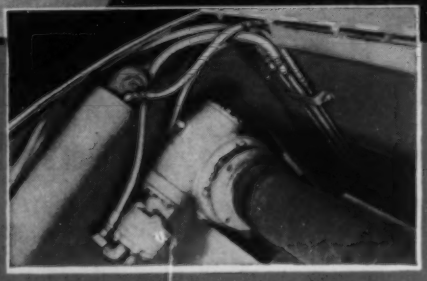
Circle 452 on page 19



THREE HYDRAULIC CONTROLS INCREASE BROOM LIFE:

1. Constant sweeping pressure maintained hydraulically with "floating" pressure, which compensates for any street irregularities.
2. Relief valve protects mechanism from curb damage.
3. Snubbing action eliminates bounce and undue wear to the broom.

HYDRAULICS IMPROVE SWEEPER PERFORMANCE



Two hydraulic circuits are used at maximum pressure of 1250 psi., supplied by direct driven pumps independent of vehicle drive.

Conveyor belt is driven hydraulically. Main broom floats under hydraulic pressure, with one lever controlling broom rotation, activating automatic belt training and conveyor belt rotation. Double acting hydraulic cylinders also open and close hopper.

Eastman—Elgin Engineering Staff Cooperate to Improve Efficiency and Service . . . Cut Manufacturing Costs

When Elgin Sweepers were converted to hydraulics, Elgin engineers enlisted the cooperation of Eastman engineers in the pilot application of Eastman Hydraulic Hose Assemblies.

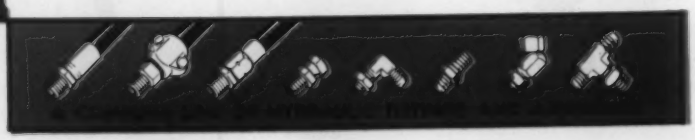
The result of Elgin's conversion to hydraulics was more than an improvement in operating performance and efficiency—it resulted in space-saving economies which permitted dramatic improvements in streamlined design—as well as reduced manufacturing and maintenance costs.

Again, as in many instances in the past . . . Elgin, who pioneered the first successfully marketed sweeper in 1912 . . . turned to Eastman—who pioneered in the very first applications of Hydraulic Hose Assemblies. LEACH PACKMASTER, an associate Elgin product, is also an original Eastman user.

We invite you to write if you have a hydraulic conversion problem. We urge you to call upon our more than 40 years of experience—unequalled in the industry. Take advantage of our many original designs and advanced construction features. Enjoy the sales prestige of Eastman Hydraulic Hose Assemblies—*Standard of the Industry!*

Eastman
first in the field

MANUFACTURING COMPANY
DEPT. MD-5, MANITOWOC, WIS.



Circle 453 on page 19

How can you use SPRING-LOCK?

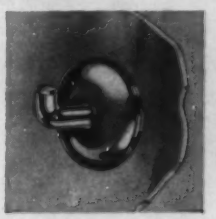
THE FASTENER WITH USES UNLIMITED

As a standard removable fastener or a blind rivet

A quarter-turn locks, unlocks. Load-carrying steel arms lock securely, don't loosen under vibration. One-piece (no receptacle) simplifies blind fastening.

As a roller axle

Now used on range drawers, kitchen cabinets, file cabinets, desks. Cuts installation costs, saves time. Designed to suit. Available with or without roller.



As cup hooks

High-strength polystyrene or chrome-plated die cast zinc. Inexpensive, sturdy and good-looking. Simply and quickly installed with a twist of the wrist.

As a cabinet door strike

Millions in use on kitchen cabinets, automatic dishwashers, etc. Standard strikes available from stock, or custom designed for special contour requirements.

As a plastic shelf support

. . . with the heart of steel for extra strength. Millions now used by all major refrigerator manufacturers. Complete flexibility of head design.

What is your application for

SPRING-LOCK?

Send us your application inquiries. Our engineers will answer you specifically and promptly. Or, write today for the Simmons Catalog. SPRING-LOCK samples are available upon request.

VISIT OUR EXHIBIT
Booth 528
1957 DESIGN ENGINEERING SHOW
New York Coliseum, May 20-23

SIMMONS FASTENER CORPORATION

1756 North Broadway, Albany 1, New York

QUICK-LOCK • SPRING-LOCK • ROTO-LOCK LINK-LOCK • DUAL-LOCK

Circle 454 on page 19

Circle 455 on page 19→

OIL-TIGHT PUSHBUTTON LINE

General Electric's oil-tight line includes: standard and mushroom-head buttons; selector switches and potentiometers; indicating lights in six colors; and other special operators. Stations are available to accommodate one to sixteen units.

ILLUMINATED PUSH BUTTON

Color caps are available in red, green, amber, white, blue and clear. Units can be furnished with guard (left on station). Transformers are available rated 110, 220 volts, 50/60 cycle or 440 volts, 60 cycle.

PUSH TO TEST INDICATING LIGHT

Faceted lens provides greater dispersion of light and gives all-angle visibility. Forms are available with the same transformer ratings and with the same six lens colors as the illuminated button.

BAKER BROTHERS, INC., Toledo, Ohio, has standardized on General Electric oil-tight push buttons for their plastic molding presses. Units are front mounted on control panel door.

ONSRUD SPAR MILLING MACHINE—operated by G-E oil-tight push buttons in flush panels and a pendant station—is made by Onsrud Machine Works, Inc., Chicago, Illinois.

ADDED TO GENERAL ELECTRIC'S OIL-TIGHT PUSH BUTTON LINE, A...

NEW illuminated push button and a NEW push to test indicating light

A new space saving illuminated push button and a quick-check, push to test indicating light have been added to the General Electric oil-tight pushbutton line. The illuminated push button is a single unit that provides the functions of both a push button and an indicating light, and can save you half your mounting area. The new push to test unit meets the newly revised JIC standards for push-to-test indicating lights. Both new units fit the same mounting hole and space as other units in the line.

BOTH NEW UNITS are furnished with one standard contact block, and a permafil encapsulated transformer with the bulb mounted on the front. The encapsulating material helps insulate the transformer windings, and provides additional strength and resistance to mechanical damage. The bulb is the new plug-in G-E No. 12, 6 volt lamp, which has extremely long life.

FLEXIBILITY in selection is one important feature of the entire General Electric oil-tight pushbutton line. Building-block construction allows you to use the same contact block with all separable operators, color rings and nameplates. Indicating lights, special units and accessories complete the line to give the many combinations you need.

FOR DETAILS of the new units and the complete oil-tight line, see your nearest General Electric Apparatus Sales Office or Distributor. Or, write for bulletin GEA-5779, Advertising Section 731-12, General Electric Co., Bloomington, Illinois.

GENERAL ELECTRIC

the editors' corner

BOOTH NO. 232

Come in and see us at the DESIGN ENGINEERING SHOW!

Pick up your copy of MACHINE DESIGN's complete Show Guide. We will also have a display of major article reprints you might want to look over.

Perhaps you have an article idea you want to talk about? Or is there a particular topic that has already appeared in MACHINE DESIGN that you want to discuss?

We'll all be on hand at the New York Coliseum May 20 through May 23, 1957.

Come in anytime during show hours. We're located in Booth No. 232—right opposite the entrance on the first floor.

the Editors

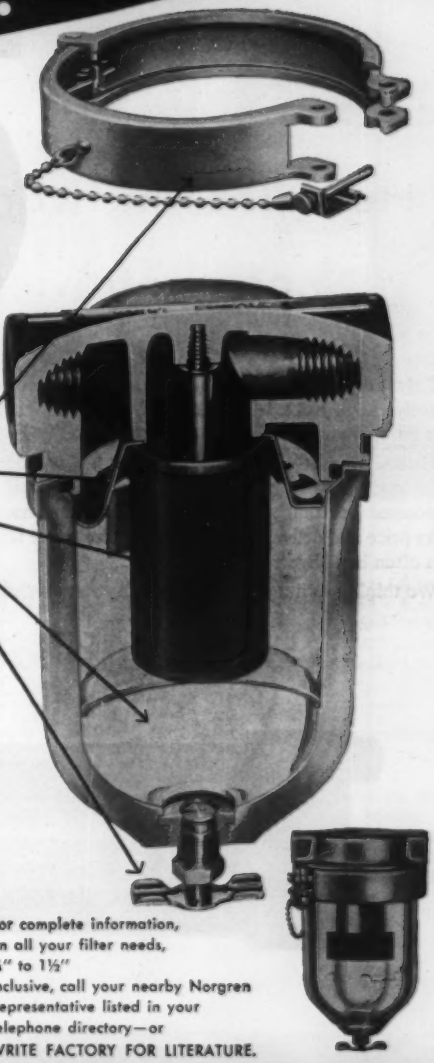
MACHINE DESIGN A PENTON PUBLICATION • CLEVELAND 13, OHIO

NBP BPA SAE

REDUCE AIR-EQUIPMENT WEAR with NEW Norgren AIR LINE FILTERS!

NORGREN FILTERS...

- *Improve Air-Equipment Operation*
- *Reduce Corrosion*
- *Reduce Wear from Abrasion*
- *Lower Maintenance and Repair Costs*



NORGREN AIR LINE FILTERS PROVIDE THESE IMPORTANT BENEFITS...

83% LESS PRESSURE DROP

GREATER LIQUID REMOVAL

COLLECTED MOISTURE IS TRAPPED in Quiet Zone

SIMPLIFIED MAINTENANCE—easy-to-operate clamp-ring.

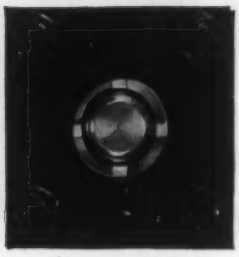
CHOICE OF 3 INTERCHANGEABLE FILTER ELEMENTS—74-micron Monel wire screen, 64 or 25-micron sintered metal.

AUTOMATIC OR MANUAL DRAIN FILTERS AVAILABLE

For complete information, on all your filter needs, ¼" to 1½" inclusive, call your nearby Norgren Representative listed in your telephone directory—or WRITE FACTORY FOR LITERATURE.

C. A. NORGREN CO.

3442 SO. ELATI STREET • • • ENGLEWOOD, COLORADO



Here are the world's finest power cylinders

...competitively priced!

This ad is written for the man who has thought all cylinders are "pretty much alike." That just isn't so, and your Hannifin man would like an opportunity to show you why...

He'll show you design features that other cylinders simply do not have... extra quality workmanship at critical points that pays off in longer life ...accessibility that simplifies their infrequent maintenance. And when he talks price and delivery, you will find these better features cost you no more, can often be delivered sooner.

We think you'll agree that it pays to standardize on Hannifin cylinders.

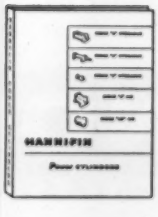
AIR AND HYDRAULIC

HANNIFIN

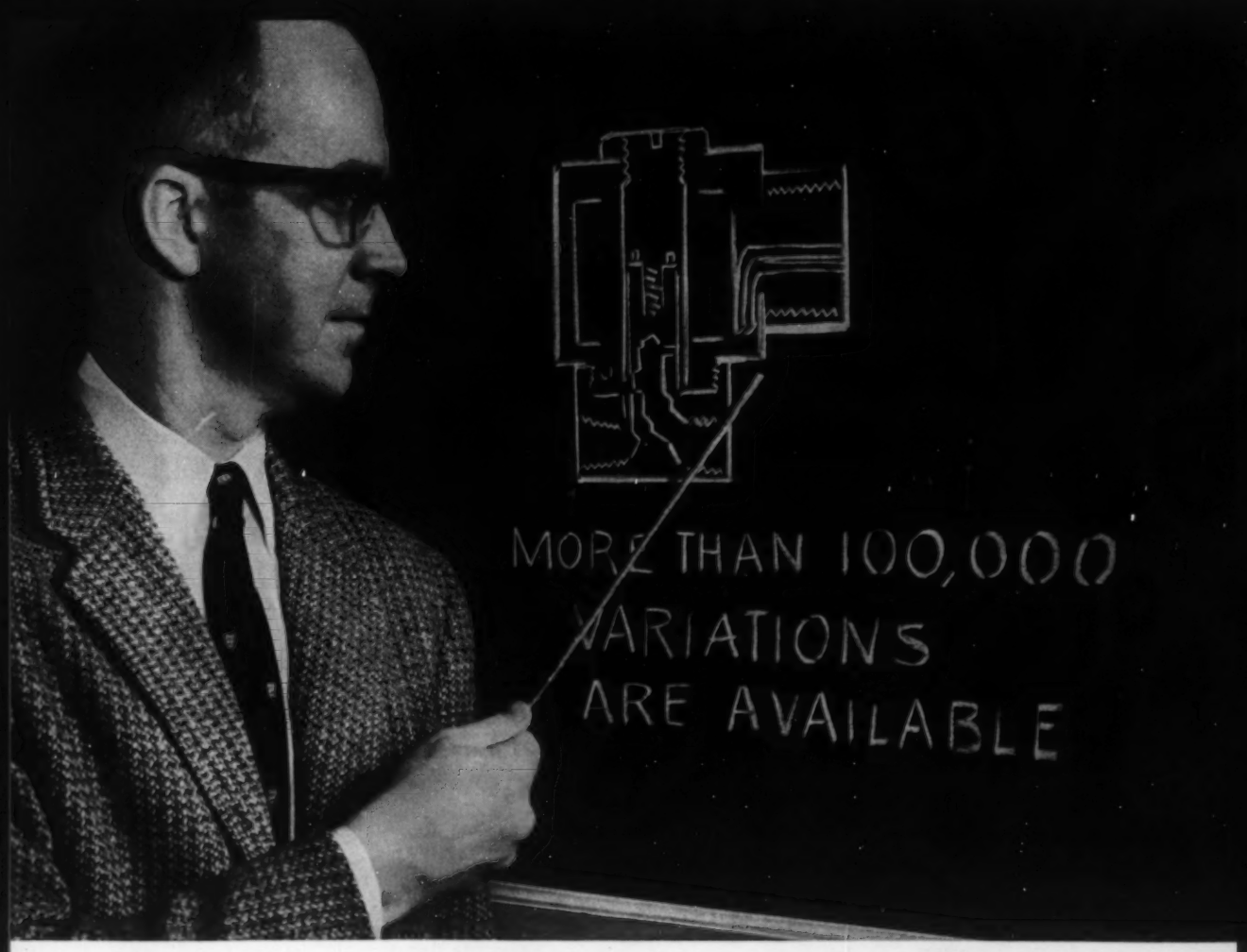
POWER CYLINDERS

COMPLETE CYLINDER FILE

Write for your copy of this new Hannifin Cylinder File . . . complete, easy-to-use, easy-to-order-from information on five lines of Hannifin Cylinders. Write Hannifin Corporation, 515 S. Wolf Road, Des Plaines, Ill.



Circle 457 on page 19



You can get the *custom designs* you want from a basic Skinner Solenoid Valve

In the small-size solenoid valve field, Skinner offers a wider variety of variations and optional features than any other manufacturer. Take, for example, the standard V5 model shown above in cutaway form. Its design is so flexible that the valve can be supplied for applications which would otherwise call for "specials." So, if you have a solenoid valve problem, we urge you to talk to a Skinner representative. Tell him your requirements in regard to port sizes and locations, voltages, pressures, temperature conditions, flow adjustments and mountings. Let him show you how easily he can select the valve you need.

When you specify Skinner, you get custom design plus outstanding service performance. Continuous testing in our labs and actual results in the field prove that Skinner valves have exceptional leakproof life. For complete information on Skinner's line of 2-, 3- and 4-way valves, write us or contact a Skinner representative. Write Dept. 425.

Skinner Solenoid Valves are distributed nationally

See us at the Design Engineering Show, Booth 708.

Circle 458 on page 19

SKINNER ELECTRIC VALVE DIVISION
NEW BRITAIN CONNECTICUT
1705 EDGEWOOD AVENUE

THE CREST OF QUALITY

SQUARE D OIL-TIGHT PUSHBUTTONS

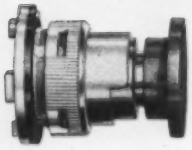
Everybody's Ahead with

THOSE WHO *Build* MACHINES

The *completeness* of Square D's pushbutton line makes a lot of sense to machine builders. Since any operator can be used with any contact block, every conceivable combination can be obtained with a minimum stock of packaged units. Another thing they like...the customer's enthusiastic approval of Square D control on the equipment they buy.

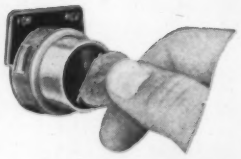
OIL-TIGHT OPERATORS

MOMENTARY CONTACT Guarded button in 7 colors.



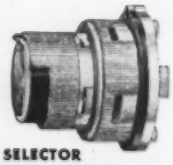
MUSHROOM BUTTON 1⅜" or 2¼". Momentary contact. 7 different colors.

SELECTOR SWITCH 2 or 3 position with 4 different cams.

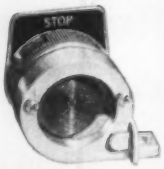


COIN OPERATED SELECTOR SWITCH Available in same selection as standard type.

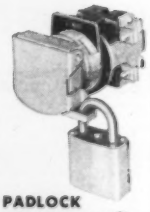
KEY OPERATED SELECTOR SWITCH Discourages unauthorized operation.



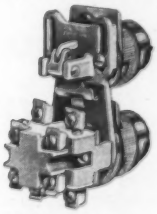
SELECTOR PUSHBUTTON combines selector switch and pushbutton. 2 or 3 position in red or black.



PADLOCK ATTACHMENT Latch type. For momentary contact buttons. Locks "off" position.



PADLOCK ATTACHMENT Cover type. Prevents depressing button.



MAINTAINED CONTACT ATTACHMENT Used with two operators and one contact block.

SELECTOR SWITCH LOCK-OUT Permits switch to be locked in any one of three positions.

WOBBLE STICK OPERATOR for momentary pushbutton operator. Ideal for emergency stop with pendant station.

NEOPRENE CAP for momentary contact button. Prevents liquids, dust and grit from working into pushbutton operator.

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE!

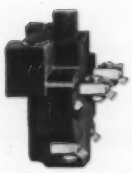
SQUARE D COMPANY

THIS MOST COMPLETE HEAVY DUTY LINE!

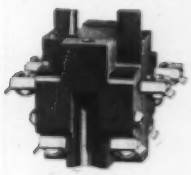
AND THOSE WHO *Buy* THEM

Performance and long life rank high with the men who buy and maintain the machines. Square D pushbuttons, designed to JIC and NMTBA standards, have been proven by severe tests involving millions of operations. They offer still other features...generous wiring space and exclusive "Slide and Swing" enclosure covers for easier, faster installations when machine operations are changed.

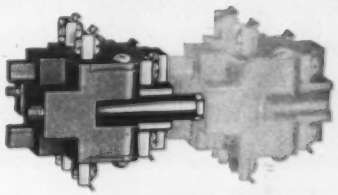
CONTACT BLOCKS and PILOT LIGHTS



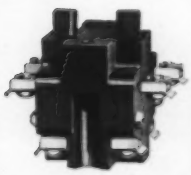
Single Pole N.O. and N.C. Contacts.



Duplex N.O. and N.C. Contacts.



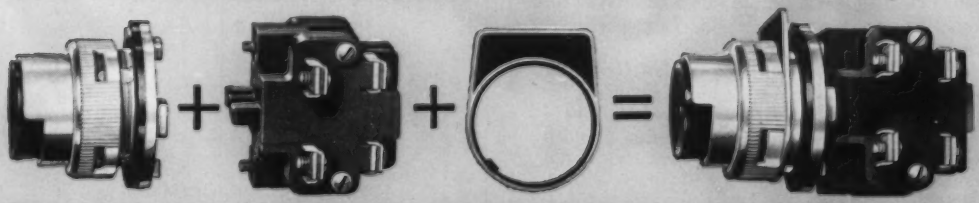
Tandem Operation. Duplex N.O. and N.C. Contacts with extended stems for combination with another block.

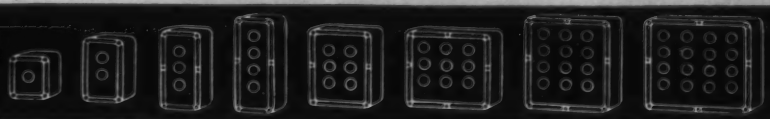


Duplex N.O. and N.C. Contacts with one N.O. circuit closing ahead of the other. Designed for 2-speed or sequence operations.

PILOT LIGHT. Generous illumination and wide-angle visibility. Greatly reduced filament burn-outs. No loosening of lamp under vibration. Six colors—red, amber, green, blue, white, clear.

ANY OPERATOR WITH ANY CONTACT BLOCK





ENCLOSURES AVAILABLE FOR 1 TO 16 UNITS

Circle 459 on page 19

Vacuum-melted alloys stay stronger, more ductile at high temperatures

Where engine temperatures exceed 1200°F, for example, vacuum-melted alloys add high strength without loss of ductility. Reason? In vacuum-melting, metals of unprecedented composition control and purity are standard. Inclusions are almost totally absent; mechanical and physical properties are higher and more uniform in all directions, and also from heat to heat. Furthermore, many alloys are readily made under the precise control of vacuum melting that are otherwise impossible or uneconomical to make at all.

Vacuum Metals Corporation, Division of Crucible Steel Company of America, is the first and largest producer of vacuum-melted metals. It is now melting heats up to 3000 pounds. Large sections and a wide variety of alloys are available to the aircraft industry. We would like to work with you on metals problems which vacuum-melted alloys may solve. Please write, giving as much detail as possible, to *Vacuum Metals Corporation, Division of Crucible Steel Company of America, P. O. Box 977, Syracuse 1, N. Y.*

Vacuum-melting is adding new performance to these metals. Do you have an application that may benefit from their use?

- High temperature alloys
- Bearing steels
- Tool steels
- High strength alloy steels
- Low alloy steels for springs
- Stainless steels
- Hard facing alloys
- Electronic alloys
- Nuclear reactor materials
- Special nonferrous alloys
- Alloys for investment castings

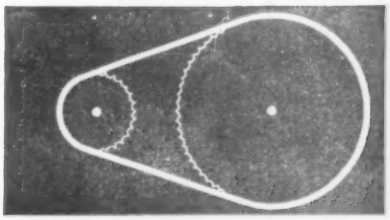
VMC®

VACUUM METALS CORPORATION

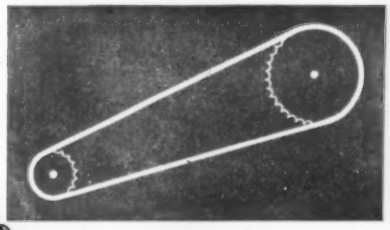
Division of Crucible Steel Company of America

Circle 460 on page 19

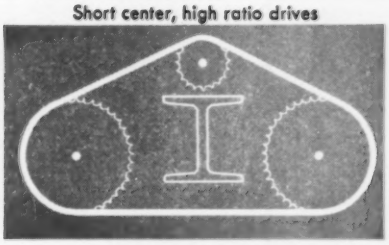
VERSATILE DIAMOND CHAINS SOLVE MANY DRIVE PROBLEMS AT LOW COST...



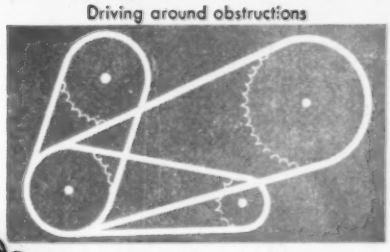
Short center, high ratio drives



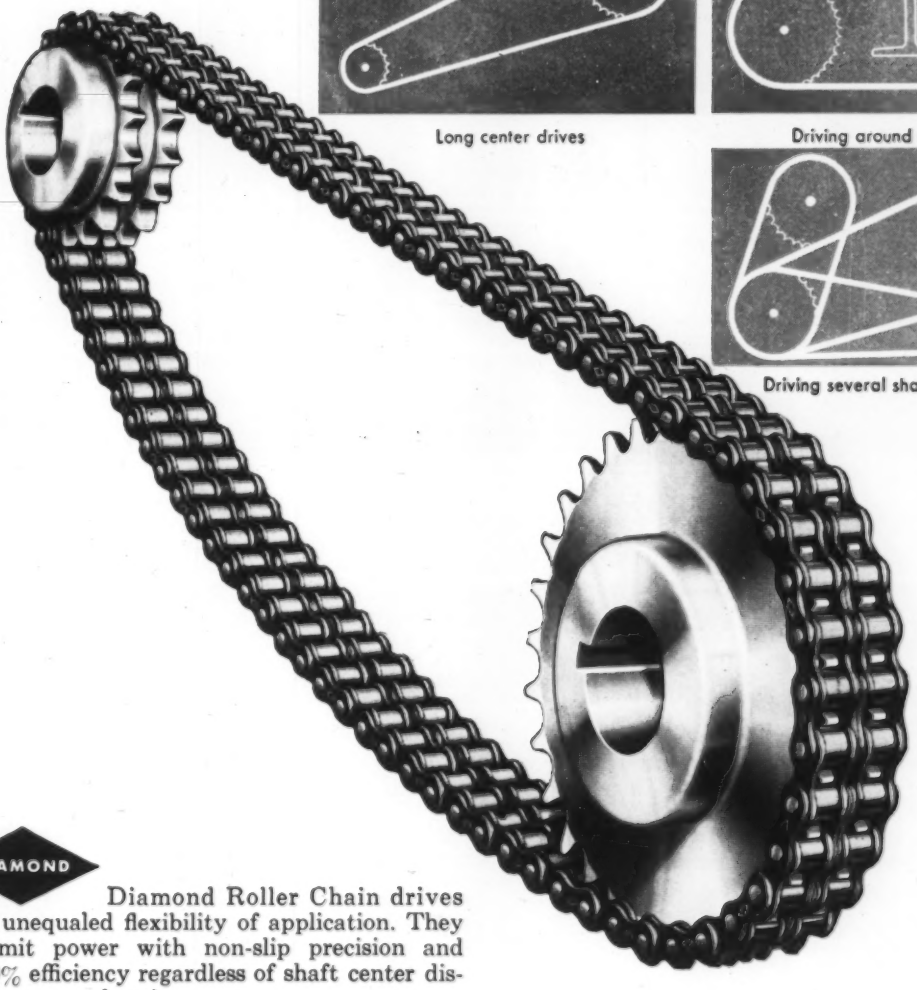
Long center drives



Driving around obstructions



Driving several shafts from one source



DIAMOND

Diamond Roller Chain drives offer unequaled flexibility of application. They transmit power with non-slip precision and 98-99% efficiency regardless of shaft center distances or speed ratios.

Obstacles in the drive path are easily avoided. Diamond Roller Chain's light weight and compactness allow lighter machinery construction, eliminate power consuming gear trains and the many shafts and bearings they require.

Diamond Engineers are available now to help you solve your drive problems. Write or call today.

DIAMOND CHAIN COMPANY, Inc.
Dept. 435 402 Kentucky Ave., Indianapolis 7, Indiana
Offices and Distributors in all Principal Cities

DIAMOND **ROLLER CHAINS**

Where High Quality is Traditional

Circle 461 on page 19

Simple Arithmetic...
Type 302, Sheet Base Price 50.00 cents per lb.
Type 430, Sheet Base Price - 39.25 cents per lb.
Saving 10.75 cents per lb.
in Stainless SHEET Costs!

Now you can SAVE $215 per ton in base price alone!

Many designers and fabricators who are currently using Type 302 stainless can, in numerous applications, specify Type 430 straight chromium stainless and take advantage of the 10¾ cents per pound difference in base price. Some of our customers are already saving more than $215 per ton using our 430 MicroRold stainless sheet.

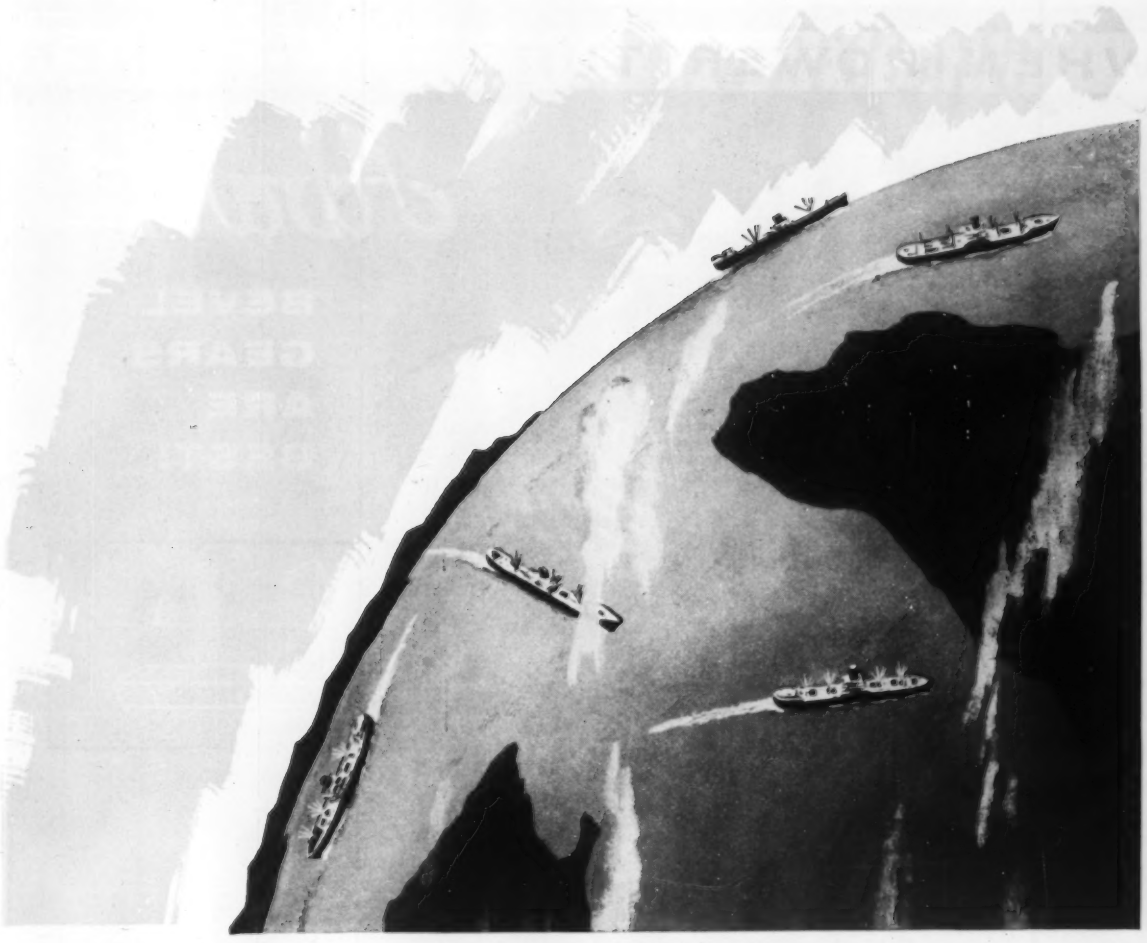
The steel industry estimates that 50% of all stainless sheet applications could satisfactorily employ Type 430, the least expensive of all stainless grades, as an economical and practical material. When properly applied, Type 430 has all the desirable qualities of beauty, corrosion resistance, strength, long life and low maintenance that no other material, except stainless, can offer.

We are currently producing our MicroRold Type 430 sheets up to 48" wide in thicknesses .005" to .109" with 2B or 2D finishes; and in thicknesses .010" to .109" in No. 3, 4 and 7 finishes.

Send for Your copy, "Care and Use of 430 MicroRold Stainless Steel"

Washington Steel *Corporation*

5-E WOODLAND AVENUE, WASHINGTON, PA.



Wherever your machinery is shipped . . .

the performance and the name are the same around the world!

FOR YEARS SHELL TELLUS OIL has been top-rated as both a lubricant and a control fluid for complex hydraulic systems. Its ability to combat foaming, oxidation, rust, sludge-formation and wear has earned it nation-wide popularity.

You may be glad to know that the equipment you manufacture can get the same efficient protection in foreign countries. Tellus* Oil is available to your foreign customers from near-by points. It will be the same Tellus Oil that your domestic customers rely upon. Write Shell Oil Company, 50 West 50th St., New York 20, New York, or 100 Bush Street, San Francisco 6, California.

*Trademark

Machinery manufacturers:
Your customers abroad will receive the same Shell Tellus Oil that your domestic customers enjoy. And this same uniformity applies to

SHELL TURBO OIL—gives anti-wear lubrication for utility, industrial and marine turbines

SHELL ALVANIA GREASE—multi-purpose industrial grease, and a complete line of other

SHELL INDUSTRIAL LUBRICANTS

SHELL TELLUS OIL

SHELL

Circle 463 on page 19

WHEN POWER TURNS A CORNER

ABART know-how in cutting precision gears covers these types and capacities...

TYPE	D.P.	P.D.
BEVEL— Max. Ratio 4 to 1	5/7 to 48	up to 6¼"
SPIRAL BEVEL—Max. Ratio and O.D. 4 to 1	up to 12	½" to 4"
SPUR	5/7 to 96	¼" to 18"
WORM	5/7 to 48	½" to 5"
WORM WHEEL	5/7 to 48	1" to 14"
HELICAL and SPIRAL	6 to 96	up to 14"
INTERNAL	5/7 to 64	½" to 12"
RACKS—Face ⅛" to 3"—max. length 24"	.....	.....
SPROCKETS—1¼" to 14" dia.	.....	.....
SPLINED SHAFTS	.....	.....

Gear Hobbing, Gear Shaving, Complete Gear Trains

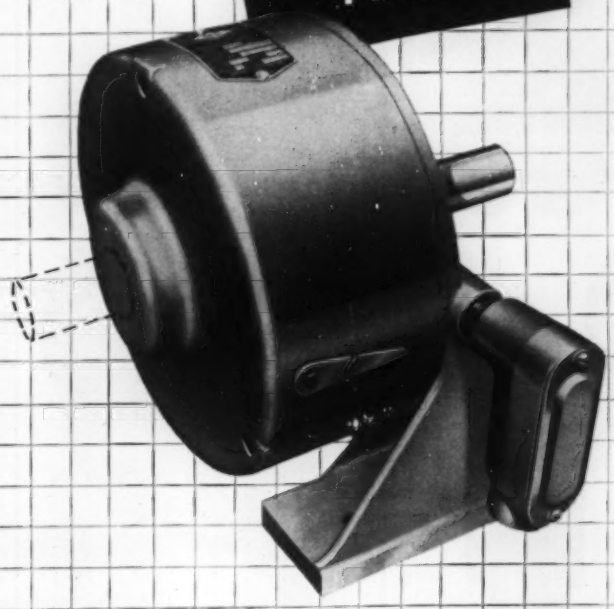
If your requirements are within these ranges your engineering department and our gear engineers can work together and save you money! We start from blue prints, specifications or an idea. (Abart carries no stocks—all gears cut to customer's specifications).

Send us your inquiries for quotation.

ABART GEAR & MACHINE CO.
4821 West 16th Street
Chicago 50, Illinois

Circle 464 on page 19

Another REULAND First!



NEW *REULAND* FOOT-MOUNTED MAGNETIC BRAKE (DISC TYPE) ...COMPLETE with SHAFT and BEARINGS

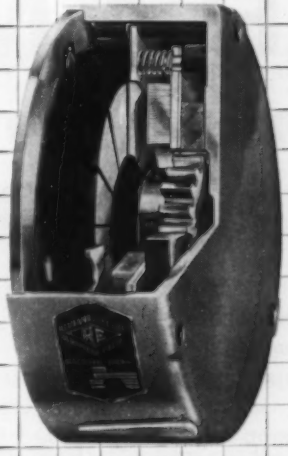
First and Only Disc-Type Brake to fulfill J. I. C. Specifications The efficient, direct-action operating advantages of the Reuland disc type magnetic brake are now available for the first time in this self-contained unit. Being foot-mounted, it can easily be coupled to existing motor or equipment shafts in accordance with J.I.C. specifications. As a standard unit it also can be purchased "off the shelf" by O.E.M.'s or added to equipment at any time by users. Available with either single or double end shaft.

Also available without shaft Reuland disc type magnetic brakes are also supplied for applications where the motor or equipment shaft can be extended directly into the brake. These units are available in both foot-mounted and endbell mounting types. Together with the completely self-contained unit described above, these brakes provide low cost, compact size and efficient operating features that are unequaled.

Reuland Brakes provide great versatility Shaft can be extended entirely through brake, when desired. Also, hook-ups with Reuland Fluid-Shaft motors and Motoreducers permit many J.I.C. and other unique power and braking combinations...combinations that can be tailored to your exact drive requirements without huge, special development costs.

Check these added features

- Automatic lining wear adjustment
- Manual release with automatic reset
- Direct action — no levers or linkage
- One-piece, totally enclosed housing
- One-half usual length — pleasing lines



Cutaway view of endbell mounting type

Other Reuland Firsts

1. Motor with internal fluid coupling
2. Spline coupled hydraulic pump motor
3. All-aluminum motor frames
4. "Xpandable" motor design
5. Slip Ring Motors in small #66 frames
6. "Through-Shaft" magnetic disc brakes
7. Precision motors for machine tools

Use these other REULAND SERVICES...

Special-Motor Library

Don't ever pay for special-motor development costs before you check this free library. Contains valuable data on hundreds of unique specially designed motors. Send for free "how to use" booklet.

Standard Motor Catalog

Contains engineering information on Reuland's complete line of standard motors and motoreducers. Sent free on request.

REULAND MOTORS

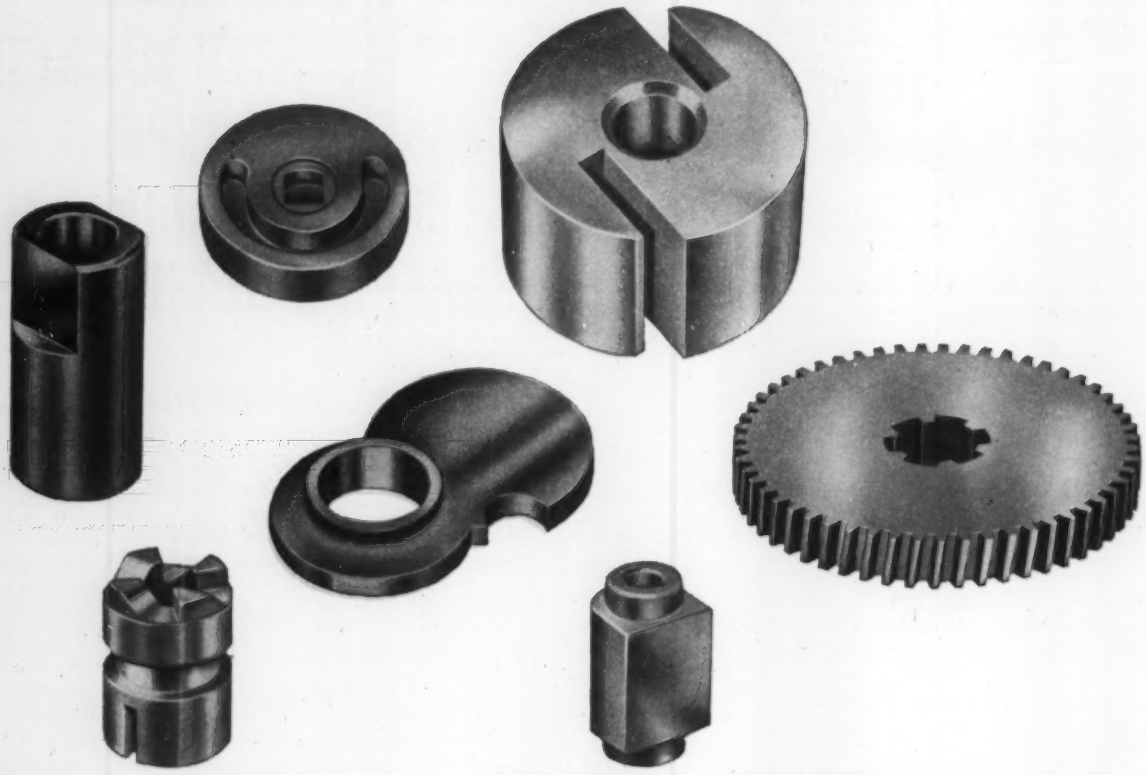
Circle 465 on page 19

REULAND ELECTRIC COMPANY

Western Division: Alhambra 81, California
Eastern Division: Howell 81, Michigan

Distributors in all principal cities

regardless of SHAPE...



economical GRAMIX®

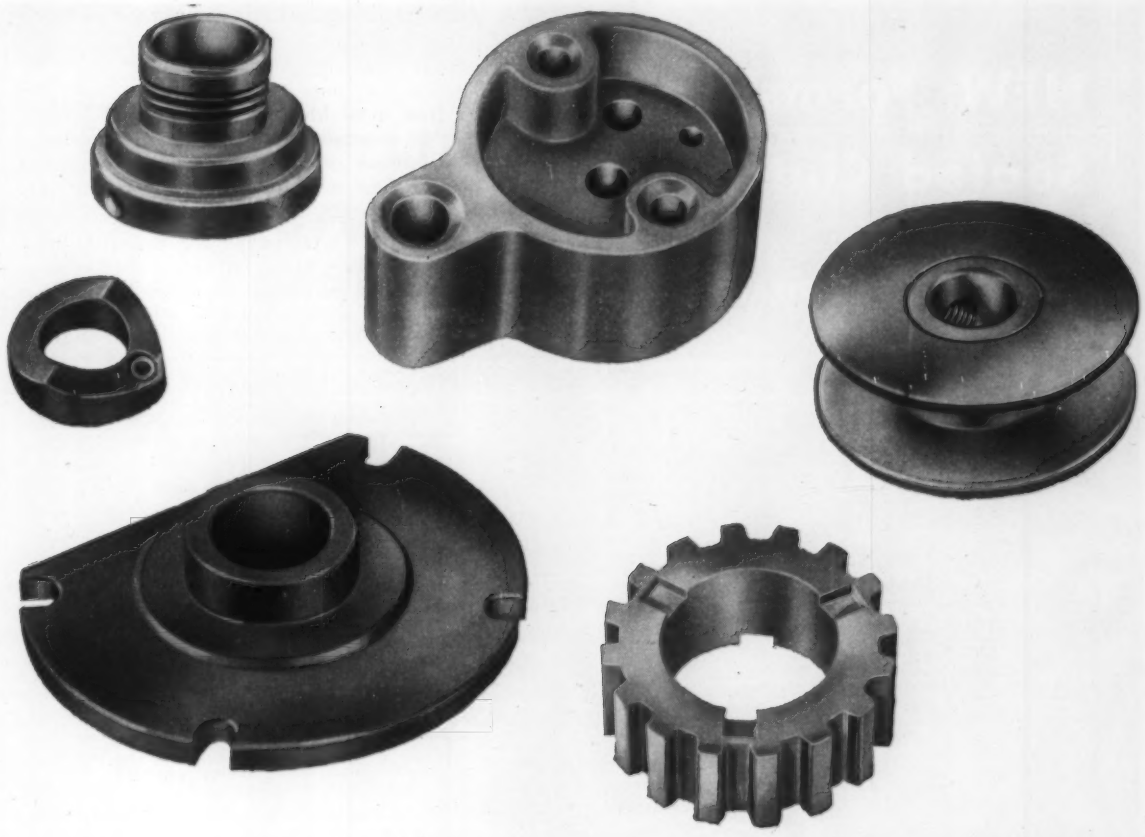
(PRODUCTS OF POWDER METALLURGY)

in the exact form to meet your ...ready to install!

Were you to machine the above parts from bar stock, or were you to finish them from rough castings or forgings, the cost would be considerable, due to their complex shapes. However, these parts—and thousands of others of comparable complexity—are produced economically by the GRAMIX process. GRAMIX parts are die-pressed to the exact shape desired, with tolerances as close as .0005", then sintered. Further machining is seldom necessary, though we often perform a coining operation to give the part a burnished, work-hardened surface. GRAMIX parts can be impregnated with various high-grade oils to furnish self-lubrication at wear surfaces. Alloys available include an extensive variety of brass, bronze, and ferrous types, and our manufacturing process allows us to accurately control the density of GRAMIX parts, assuring a uniform structure. There is probably a component in your product that could be improved with GRAMIX sintered metal parts . . . Have you given it consideration?

THE UNITED STATES

GRAPHITAR® CARBON-GRAPHITE • GRAMIX® SINTERED METAL PARTS • MEXICAN® GRAPHITE PRODUCTS • USG® BRUSHES



machine parts can be made design requirements . . .

ENGINEERING BULLETIN No. 19

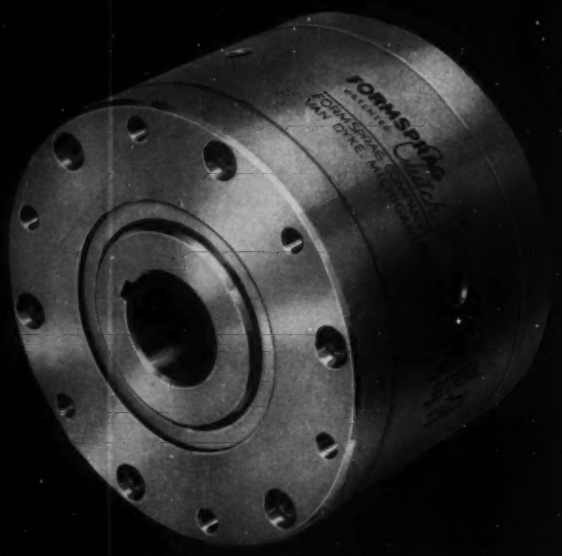
Product engineers specifying materials will find a wealth of design information in this GRAMIX Machine Parts Bulletin. This material is presented in such concise form that questions are quickly and easily answered. A simple chart indicates which alloys—ferrous and non-ferrous—are suitable for different operating requirements. Working sketches show the various design possibilities—radii, helical teeth, dead-end holes, flanges, multiple shoulders—and how they can be utilized to best advantage. Physical properties are presented, and metallography discussed. In all, you'll find Bulletin 19 an ideally simplified guide to a complex subject . . . write now for your copy. 118

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 7, MICHIGAN

NEW: Formsprag Sealed Clutch Series

LOCKS LUBRICANT IN



SEALS DIRT OUT

Now available—the new series "B" and "C" Formsprag Ball Bearing Sealed Clutches – designed for backstopping, indexing and low speed over-running where inner race over-runs.

The "B" is intended for over-running applications where both races rotate during some portion of the operating cycle. The "C" series should be selected if the application is one of indexing or if the outer race is to be fixed, as in a backstopping application.

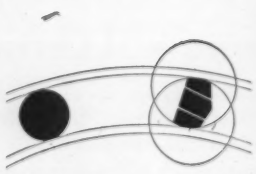
Available in bore diameters ranging from 2¼" to 5½", these new clutches have torque capacities from 1875 to 11,600 ft.-lbs. So you get unusually compact power transmission, the ultimate in accuracy, and exceptionally long service life. What's more Formsprag clutches may be reconditioned twice before obsolescence at a fraction of the cost of a new clutch.

CHECK THESE CAPACITIES

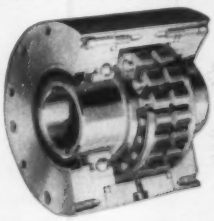
Model No.	Maximum over-running speed RPM	Torque capacity lb.-ft.	Maximum bore diameter
FSB-700	900	1,875	2¼"
FSB & FSC-750	600	3,160	2¾"
FSB & FSC-800	600	4,200	3½"
FSB & FSC-900	600	6,000	4½"
FSB & FSC-1000	500	11,600	5½"

WHY IT PAYS TO DESIGN "THE FORMSPRAG PRINCIPLE" INTO YOUR PRODUCT

Sprags are an advanced design of precision wedges made of hardened alloy steel. Utilized in a clutch, they increase the efficiency and prolong the life of all equipment using an over-running clutch or ratchet.



The sprag is, in effect, a "roller" of increased diameter with greater contact surface in a given annular space—therefore, of increased torque capacity.



Designed for backstopping, indexing and low speed over-running service where inner race over-runs. Formsprag will make selection of either "B" or "C" series when application data sheet accompanies order.

MORE INFORMATION?

Should you require details on these Formsprag small clutches as well as the complete line, write today for this new 26-page catalog.

Over-Running, Indexing and Backstopping Clutches for aircraft, automotive and various industrial applications

FORMSPRAG COMPANY

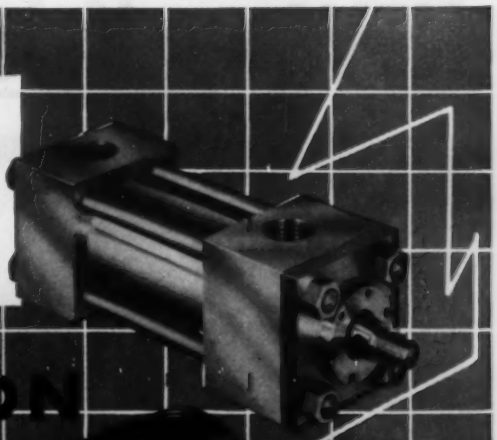
VISIT BOOTH 208, Design Engineering Show. Coliseum, New York, May 20-23

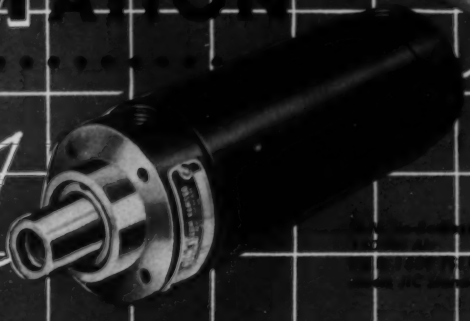
23603 HOOVER ROAD, VAN DYKE (DETROIT), MICH.

World's largest exclusive manufacturer of over-running clutches. Distributors in principal cities.

A7-5C

O-M CYLINDERS (AIR AND HYDRAULIC) are an integral part of AUTO-MATION





Engineering Service—

ORTMAN-MILLER MACHINE COMPANY

7 143rd Street, Hammond, Indiana

☐ Have representative call

☐ Send Bulletins 101A and 105

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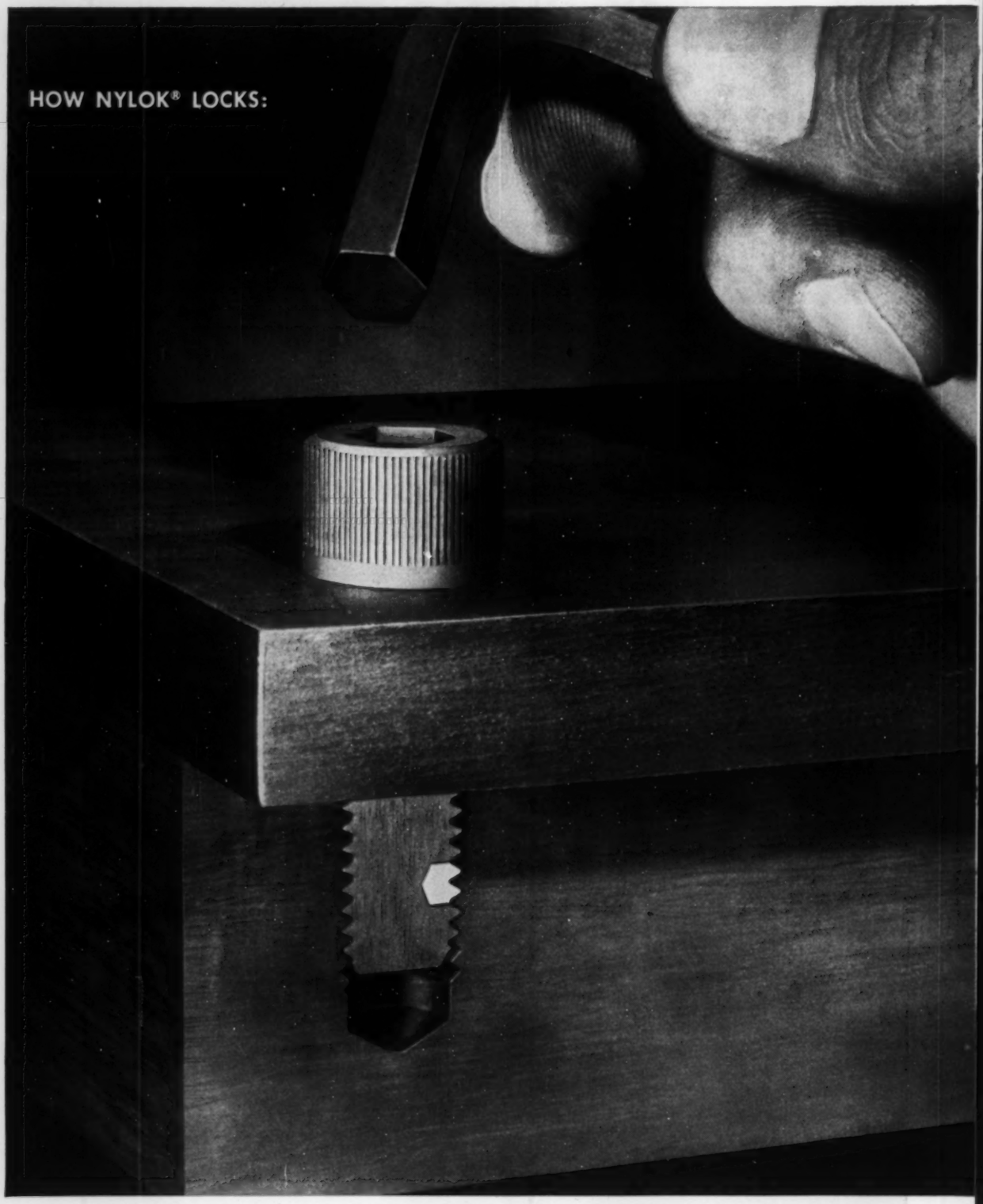
Company_____

Address_____

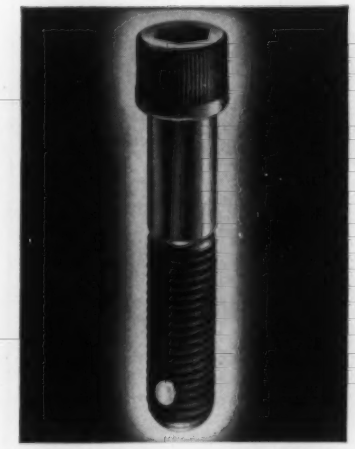
City_____ Zone____ State_____

NEW—self-locking UNBRAKO



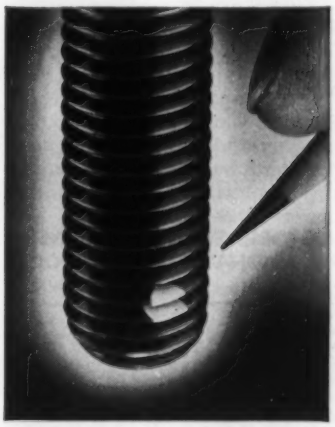
LOCKED! The tough, resilient nylon pellet keys itself into the mating threads. It forces threads together and locks the screw securely.

socket head cap screws



Self-locking UNBRAKO socket head cap screw.

BEFORE ASSEMBLY. The nylon pellet projects slightly. When assembled, threads will be impressed into it.



AFTER REMOVAL. "Plastic memory" of pellet has expanded impressed threads to greater diameter than screw threads. Screw can be used repeatedly. In use, "memory" keeps threads tightly locked.

They won't work loose. And they simplify design and save production time.

UNBRAKO socket head cap screws are now available embodying the Nylok* self-locking principle. Nylok provides the first truly practical solution to the problem of making cap screws self-locking.

An UNBRAKO cap screw with Nylok is a single self-locking unit. No auxiliary locking devices are needed. Just thread the UNBRAKO into any tapped hole. *Seated or not*, it locks positively wherever wrenching stops. The tough, resilient nylon pellet forces mating threads together and holds tight. The screw will not work loose.

You save production time when you make products with self-locking UNBRAKOS. And you get greater simplicity in design with less bulk and weight. The number of parts you must assemble to achieve full locking action is reduced to the absolute minimum. Lockwashers under screw heads are no longer necessary. Costly wiring of cross drilled heads is eliminated. And in many cases you will save weight and mass by using shorter screws in tapped holes instead of drilling through and using nuts and lockwashers.

Self-locking UNBRAKOS are reusable. They have uniform locking and installation torques—with no galling or seizing on mating threads. They successfully withstand temperatures from —70° to 250°F. And, when screws are properly seated, the locking pellet also functions as a liquid seal.

A complete line of self-locking UNBRAKO socket screw products, in a wide range of standard sizes, materials and finishes, is available through your authorized industrial distributor. Technical data and specifications are detailed in Bulletin 2193. Write us for your copy today. Unbrako Socket Screw Division, STANDARD PRESSED STEEL CO., Jenkintown 18, Pa.

T.M. Reg. U.S. Pat. Off., The Nylok Corporation

See us at the Design Engineering Show, May 20 to 23, New York Coliseum, Booth #416

UNBRAKO SOCKET SCREW DIVISION

STANDARD PRESSED STEEL CO.

SPS

JENKINTOWN PENNSYLVANIA

Circle 469 on page 19

for dependable power in controls and timing devices

SYNCHRON®
TIMING MOTORS

precision made
accurate
trouble free
tested 51 times
... by HANSEN

the SYNCHRON line
designed, built and tested for long life

8 IN. OZ. STANDARD TIMING MOTOR

Widely used in timing machines, time switches, heating and air conditioning controls, action signs, recording thermometers, and other timing devices. Guaranteed to pull 8 oz. direct load continuously at 1 r.p.m.

20 IN. OZ. HI-TORQUE TIMING MOTOR

Ideal power for timing applications requiring continuous motion. Guaranteed for one year. Instant starting, dependable accuracy, and flexible installations. Guaranteed 20 in. oz. at 1 r.p.m.

UL AND CSA APPROVED

NEW! 1 R.P.H. TIMING MOTOR

Guaranteed to pull 20 in. oz. at 1 r.p.h. (1/60 r.p.m.). Synchron's especially developed motor for slow motion timing applications.

the SYNCHRON line
designed, built and tested for long life

SYNCHRON CLOCK MOVEMENTS

Split-second accuracy and long wearing construction, never needs oiling. Front, rear or bottom set, with or without dustproof case. Simple mounting cuts production and assembly costs.

HANSEN MAGNA-TORC DIRECT CURRENT MOTOR

Designed for aircraft instruments and radio controls mechanisms. During World War Two it proved rugged dependability in all attitudes and climatic conditions. Easily adapted to other commercial applications.

"Workhorse of the industry"

Synchron synchronous motors operate smoothly, evenly in any position; at temperatures from −40° to +140° F.; start instantly under load; pull up to 20 in. oz. at 1 RPM. Available in 42 speeds from 0.8 RPM to 600 RPM.

Synchron timing motors in all speeds available for prompt delivery.

SYNCHRON®

SYNCHRONOUS MOTORS, TIMING MACHINES, CLOCK MOVEMENTS, MAGNATORC D.C. MOTORS

HANSEN MFG. CO., INC.
OUR 50TH YEAR

Princeton 12, Indiana

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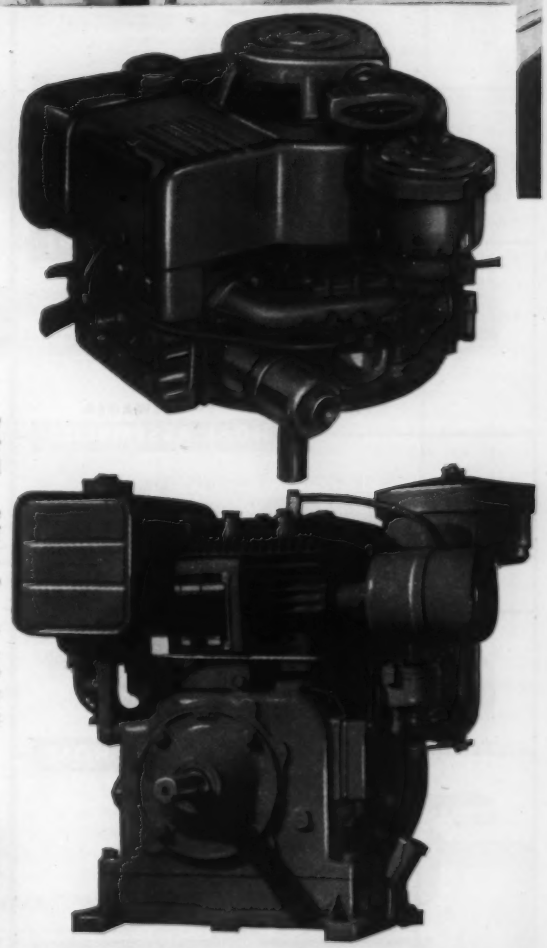
HANSEN REPRESENTATIVES: The Fromm Co., 5254 W. Madison St., Chicago, Ill. • R. H. Winslow Assoc., 123 E. 37th St., New York, N.Y. • Electric Motor Engineering, Inc., 8255 Beverly Blvd., Los Angeles 48, Cal. and 3907 Lyon Ave., Oakland, Cal. • H. C. Johnson Agencies, Inc., Rochester, Buffalo, Syracuse, Binghamton, New York.

Power partners that add to the prestige of your product!



Why? Because Briggs & Stratton engines — *No. 1 in use throughout the world* — bring your products added user preference . . . added prestige and value from a sales and profits standpoint.

The vertical shaft 2.25-hp light weight engine and the new horizontal shaft 7-hp Model 19 at right — are two of many models up to 9 hp in the Briggs & Stratton line. You get a wide choice that means greater opportunity to find the correct power for your products.

And for assistance that may help reduce board time, utilize Briggs & Stratton's consulting engineering service. It's likely they already have the answers to some of the power application problems you're now facing. Remember too, wherever your product is used — authorized Briggs & Stratton service is nearby.

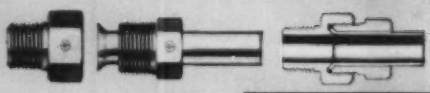
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES

BRIGGS & STRATTON CORPORATION
MILWAUKEE 1, WISCONSIN

Circle 471 on page 19

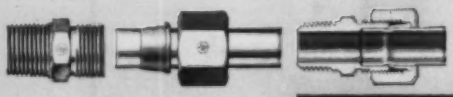
Best for your product, too!

SAE 45° FLARE

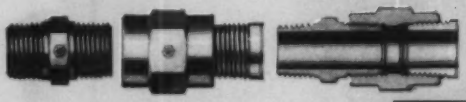


INVERTED FLARE

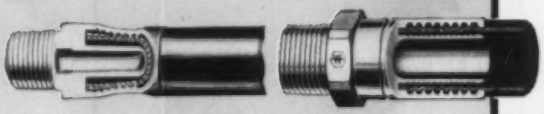
COMPRESSION



SELFALIGN®

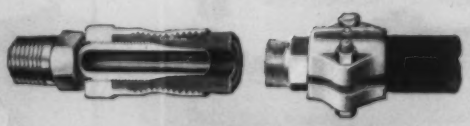


PIPE

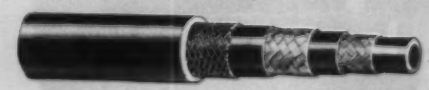


CRIMPED SWAGED

HOSE ASSEMBLIES



REUSABLE HOSE ENDS



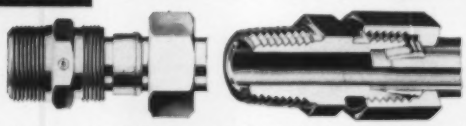
BULK HOSE

DRAIN AND SHUTOFF COCKS

WEATHERHEAD

EVERY COMPONENT TO MEET ANY HYDRAULIC REQUIREMENT

ERMETO®



Steel and stainless steel Ermeto fittings in sizes and types to meet any need. No flaring, threading, welding or soldering.

STRAIGHT-THREAD ERMETO

Straight-thread Ermeto meets new S.A.E. Boss specifications. Closer coupling; higher PSI without backup rings. New "Weathercote" finish for greater corrosion resistance.

S.A.E. 37° FLARE-TWIN (J.I.C.)

3-PIECE

2-PIECE

37° flared fittings available with dryseal pipe-thread or with new straight-thread in popular styles and sizes for S.A.E. O-ring design boss. Withstands higher pressures without backup rings. Easier assembly, closer coupling. Corrosion-resistant "weathercote" finish.

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FIRST IN HYDRAULIC CONNECTIONS

THE WEATHERHEAD CO., FORT WAYNE DIVISION

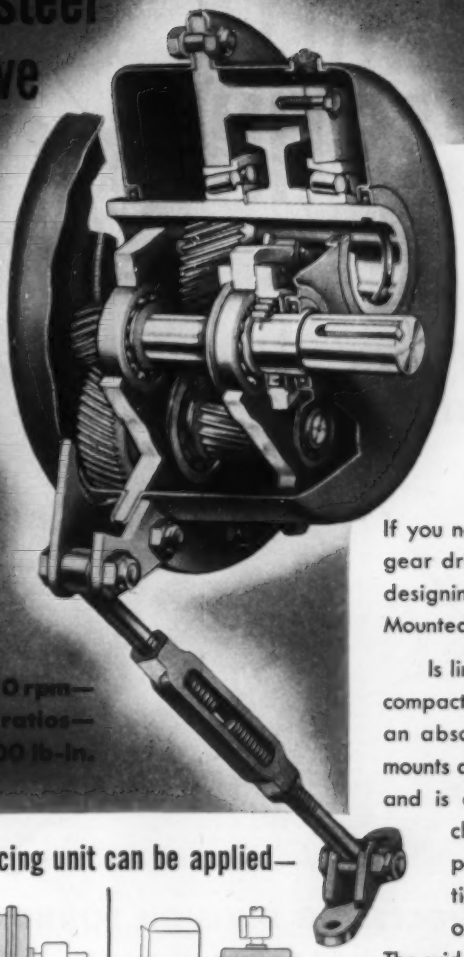
Dept. AB-5, 128 West Washington Blvd., Fort Wayne, Indiana

In Canada: The Weatherhead Co., Ltd., St. Thomas, Ontario

Circle 472 on page 19

The FALK all-steel Shaft Mounted Drive

- *Versatile*
- *Efficient*
- *Economical*
- *Compact*



SIX SIZES—½ TO 30 HP—420 to 10 rpm—single and two double-reduction ratios—output torque ratings up to 21,000 lb-in.

To Design men:

If you need an efficient, economical gear drive for the machine you are designing, the all-steel FALK Shaft Mounted Drive is your answer.

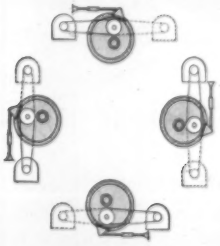
Is limited space a problem? This compact speed-reducing unit requires an absolute minimum of space. It mounts directly onto the driven shaft, and is driven through a V-belt or chain from any convenient power source. Unit can be positioned in countless ways, some of which are sketched below. The widest choice of output speeds is made possible by varying driving sheaves or sprockets.

Designed and geared by FALK, recognized leader in gear manufacture, this Shaft Mounted Drive will be a dependable component of your machine.

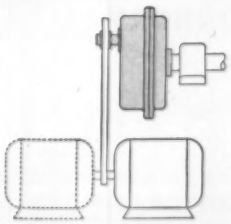
★

FALK Shaft Mounted Drives are available from factory stocks *from coast to coast.* See your Falk Representative—or write direct for copy of **Bulletin 7101.**

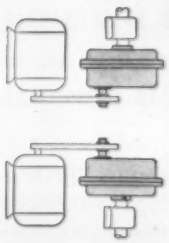
A few of the many ways this reducing unit can be applied—



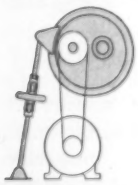
ANY POSITION



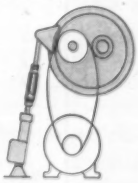
MOTOR EXTENDED —or below the unit



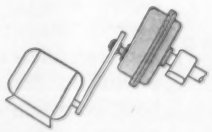
VERTICAL—UP or DOWN



VARIABLE SPEEDS... through use of variable-pitch sheaves—automatic belt adjustment with tie-rod adjustment



OVERLOAD RELEASE... that will slacken belts and cut off power if overload occurs



INCLINED SHAFT... Any standard unit can be mounted in vertical or inclined position by a simple rearrangement of oil drains

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Representatives and Distributors in Most Principal Cities

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- Motoreducers
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FALK

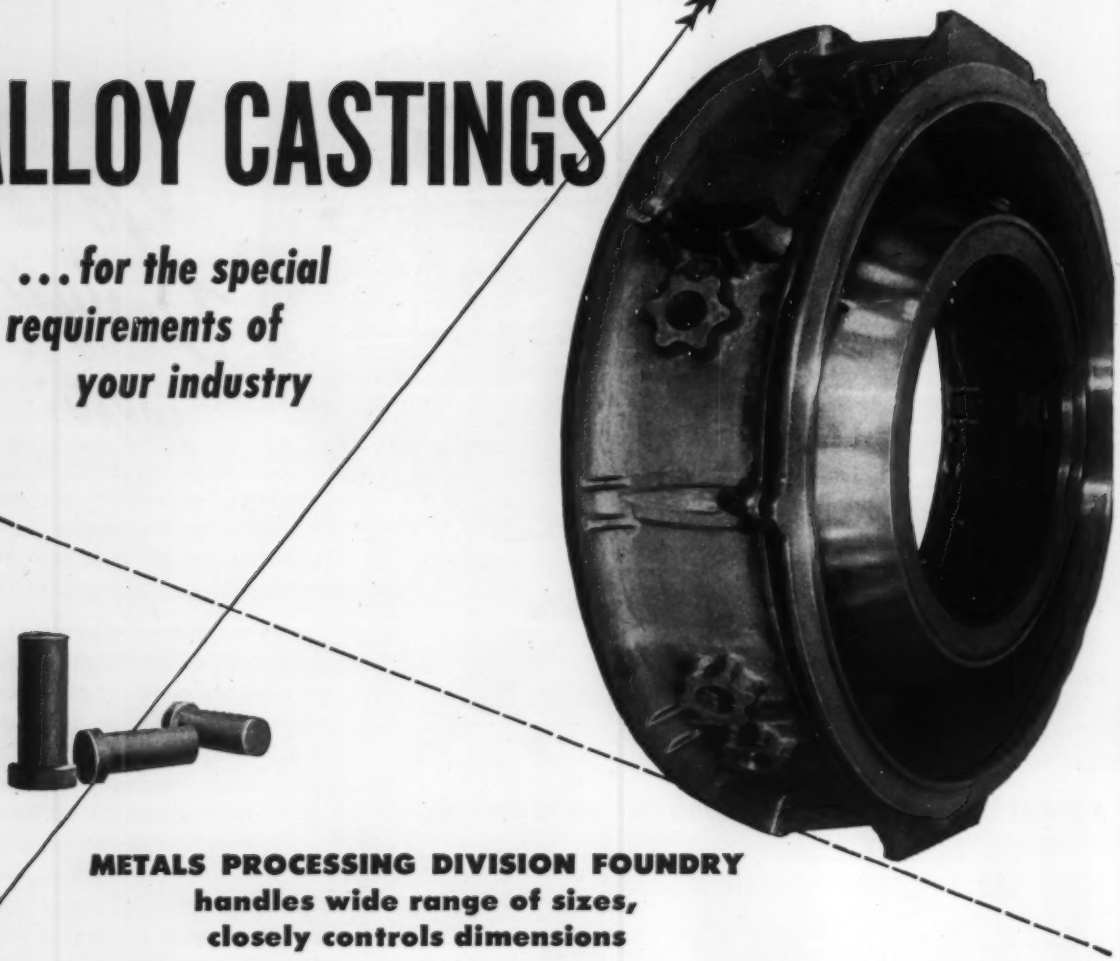
...a good name in industry

Circle 473 on page 19

AIRCRAFT QUALITY

ALLOY CASTINGS

...for the special requirements of your industry



METALS PROCESSING DIVISION FOUNDRY
handles wide range of sizes, closely controls dimensions

Precision testing methods provide close control of casting quality

Curtiss-Wright's Metals Processing Division today offers your industry precision castings of critical parts in a wide variety of sizes, and with closely controlled dimensions. For example, in the large casting shown, tolerance is ±.030 over 36″ diameter. From its modern, completely equipped foundry in Buffalo, the Division supplies heat, corrosion and abrasion resistant castings from a full range of special-property alloys, including ductile iron...by sand, centrifugal, ceramic or shell processes.

Precision alloying techniques, modern melting controls with spectrometer testing, X-ray control by experienced radiographers — all add up to castings with superior physical and mechanical properties . . . mean better and more dependable products for the critical needs of industry. Qualified design engineering assistance is a part of the comprehensive Metals Processing Division service. Write for details.

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Metals Processing Division Branch Offices: New York • Houston • Los Angeles

Circle 474 on page 19

VICKERS® HYDRAULICS

MINIATURIZED PISTON TYPE PUMPS are made in four size series. Unit shown packs 4.3 hp in 0.9 lb.
PACKAGED HYDRAULIC SYSTEM means complete compatability of components and the responsibility for design, manufacture and performance testing by a single responsible source. Output is approx. 2.5 equiv. hp; length approx. 14"; weight approx. 13.5 lb.
PACKAGED HYDRAULIC SYSTEM provides small envelope, reduced weight, minimum piping, and "plug-in" construction for easy installation and servicing. Output is approx. 2.5 hp; length approx. 13½"; weight approx. 19.5 lb. (including power source).
ELECTRICAL POWER PACKAGE uses hydraulic system to provide closely regulated 400 cycle, AC power with minimum weight and envelope. 1 kva package shown weighs only 10.5 lb.

for Guided Missiles

As the rapidly-expanding missile program progresses, more and more applications are being found where Vickers Hydraulics will be used to advantage. Vickers has miniaturized components that can be integrated into system packages with minimum tubing . . . manifolding components gives no opportunity for leakage. These "packaged" systems with their optimum performance and *reliability* are used to power missile control surfaces. Minimum space and weight, easy installation and servicing are other important advantages. Get in touch with the nearest office listed at the right for further information.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION

Aero Hydraulics Division
Engineering, Sales and Service Offices:

Administrative & Engineering Center
Detroit 32, Michigan

3201 Lomita Blvd.
P.O. Box 2003
Torrance, California

District Sales and Service Offices:
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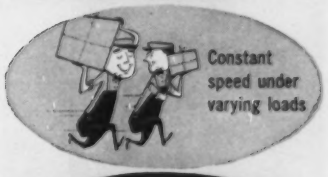
7643

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

See the Louis Allis "Syncro-Spede" in action at the Design Engineering Show, New York Coliseum, May 20th to 23rd, Booth 417-419.



They look like twins — but one is synchronous

Louis Allis "Syncro-Spede"* offers—for the first time—a synchronous motor in the same frame sizes as a standard induction motor

New from Louis Allis — *the most compact and efficient synchronous induction motor on the market* . . . the revolutionary "Syncro-Spede." It's the *only* synchronous motor built in standard NEMA frames for comparable ratings in any enclosure.

The space-saving "Syncro-Spede" has no external excitation, wound rotating fields, collector rings or brushes—offers simplified control and low-cost operation, virtually maintenance-free.

In performance, "Syncro-Spede" delivers and maintains exact synchronous speed within its rated capacity, regardless of load variations or voltage dips. When powered by a single adjustable frequency source acceleration, running speed, and deceleration of several different ratings of "Syncro-Spede" motors can be synchronized.

"Syncro-Spede" is the low-cost answer to such demanding synchronous applications as *precise adjustable-frequency multi-motor systems*... high-frequency generator drives and constant-speed conveyor drives . . . precision timing and metering devices . . . recording instrument drives . . . any system requiring constant speeds from no-load to full-load.

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Circle 476 on page 19

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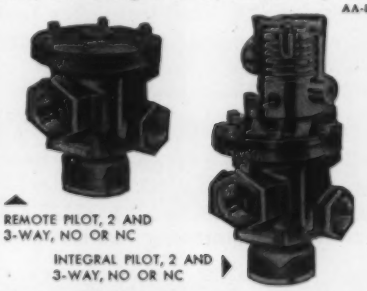

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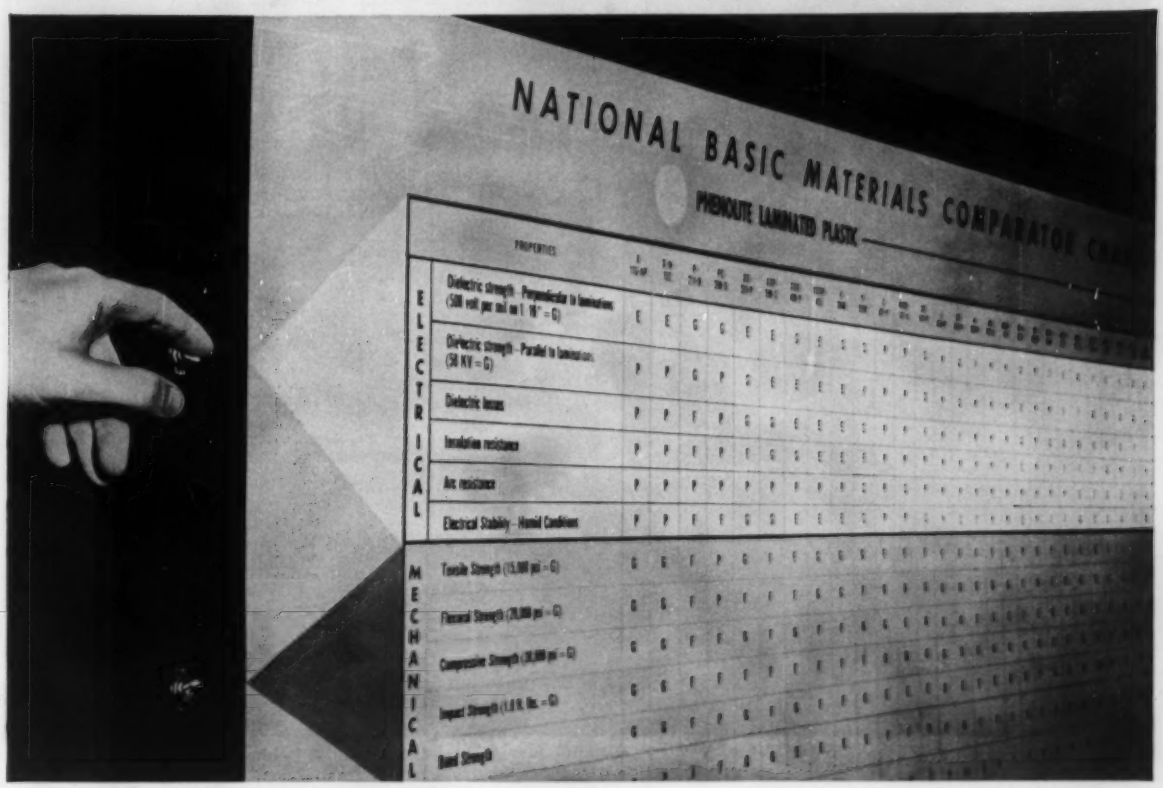

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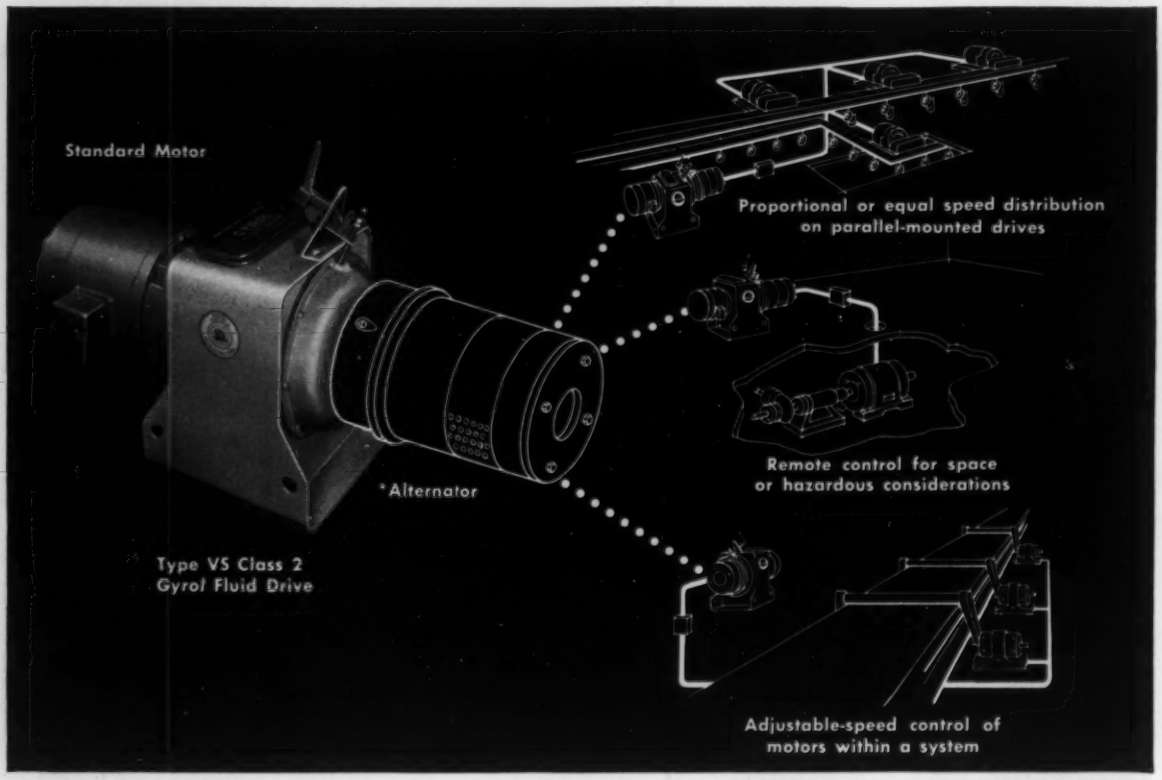
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Matched, adjustable-speed control of AC induction motors lets you control speeds in coordinated production processes

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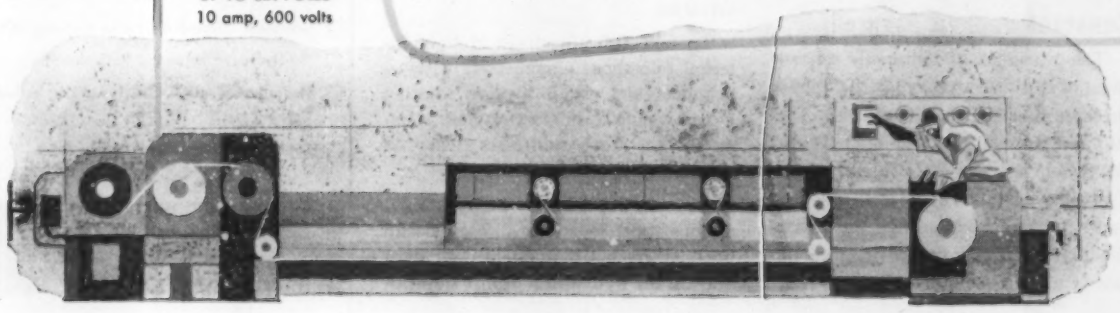
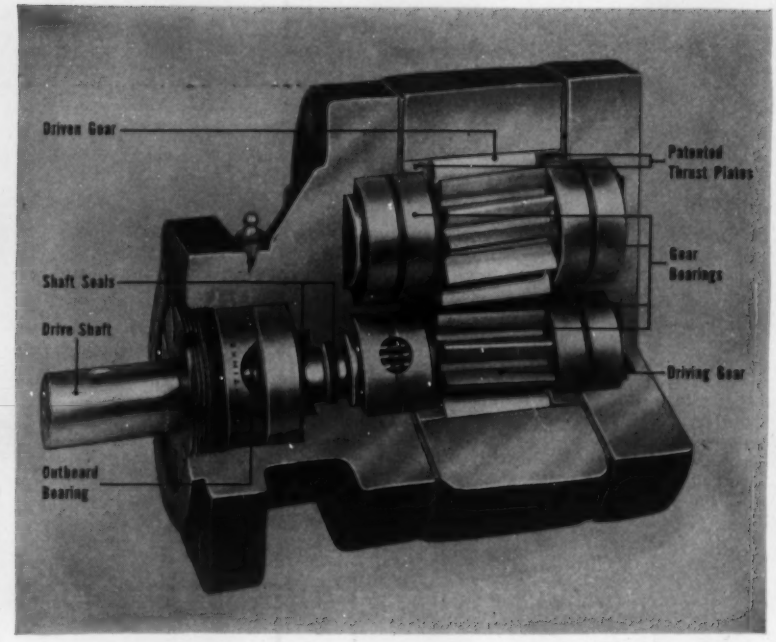


Circle 480 on page 19

(Advertisement)

ADVANCES IN HYDRAULIC PUMP DESIGN



Oil leakage controlled

In any method of mounting an oil-hydraulic pump there is always a certain amount of misalignment between the pump drive shaft and the shaft on the power source. Even where universal drives are utilized there is still the danger of a thrust load. Result in both cases: Flexing is transmitted into the pump seal and eventually to the bearings supporting the gear—leakage around the shaft is a sure-fire bet to follow.

At Commercial, by using an outboard bearing to protect the seals and internal bearings, the common leakage nuisance is eliminated.

Internal alignment perfected

Mass production of independent gear pump housing parts invariably results in varying degrees of internal misalignment—regardless of dowel pin control points used in machining. In many cases the "out" for the problem involves a loosening up on the internal tolerances—with a resultant loss in efficiency.

At Commercial, the patented thrust plate serves as a "natural" alignment control point—is counter bored on its face to match the bearing sleeve, then fits over the bearing sleeve and in turn pilots inside the gear housing. Perfect internal alignment—and increased efficiency—in any Commercial oil-hydraulic pump is axiomatic with rigid inspection of the thrust plate alone.

Constant volume assured

The principle of automatic adjustment of end clearance by internal pump pressure had one main weakness. The full pump pressure was applied against the whole area of each thrust plate. The plates would wear unevenly because on the inlet side of the pump the plate had full pump pressure on one face and a vacuum on the gear side.

By "pressure pocketing" Commercial insured that the pressures on opposite faces of the thrust plates would be in approximate balance around the entire area of the plate faces. Commercial's "one-two" advance design punch—the patented "pressure pocketed" thrust plate—assures constant volume at any pressure and at the same time helps to maintain simplicity of design and soundness of construction . . . provides for longer operating life and no maintenance headaches.

Seizing eliminated

Commercial oil-hydraulic pumps cannot seize because of heat induced by high speed or even inadequately piped systems. Variable end clearance and positive internal alignment make seizing practically impossible. Bearings evenly loaded throughout their length—no corner loading or spawling—are able to withstand much higher operating pressures. They stay in service longer too—regardless of pressures involved.

To take full advantage of tight internal tolerances Commercial designs, produces and grinds its own rotating gears—is able to hold extra close tolerances on tooth contours, outside diameters, and concentricity.

Over 5,000 different pump combinations—port locations and sizes—can be built from Commercial's standard line of oil-hydraulic pump components. A wide variety of drive shafts and mounting combinations are available to solve virtually any individual installation, piping and power application requirement.

Engineering help available

Commercial's oil-hydraulic pump engineering advances are typical of its complete line of oil-hydraulic equipment. The solid technical help Commercial sales engineers can contribute on the application of oil-hydraulic pumps, motors, cylinders and valves may be able to help cut your costs and improve performance.

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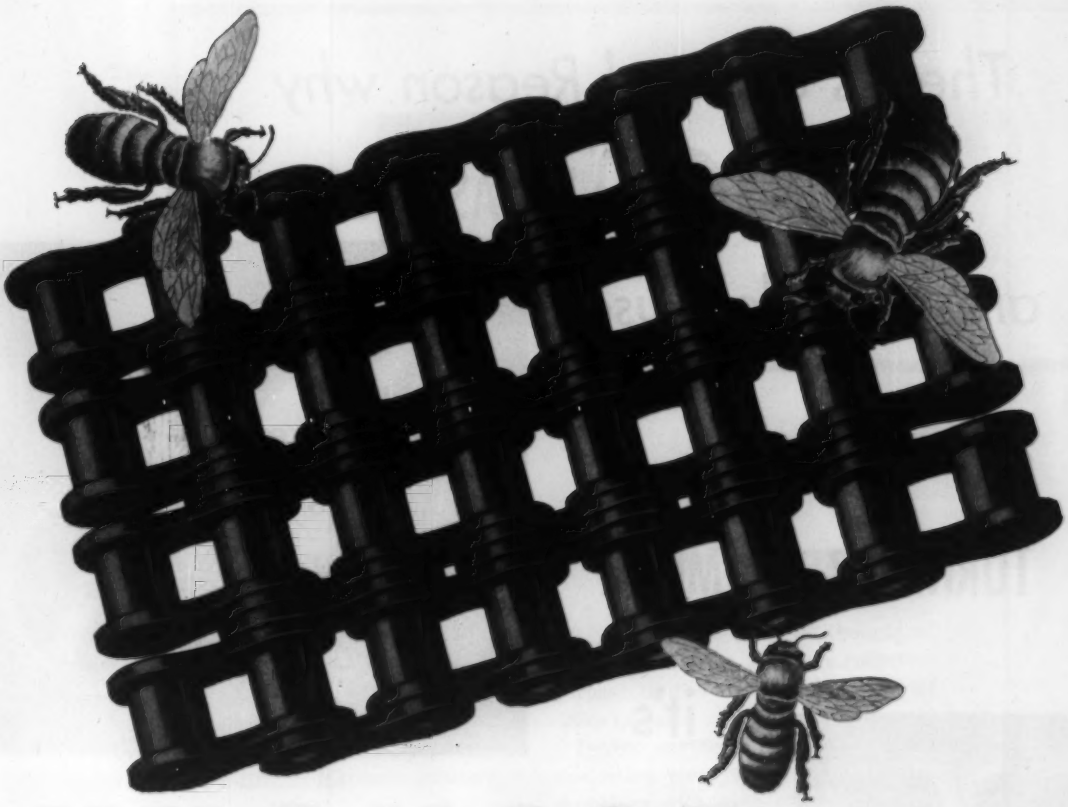
Circle 481 on page 19



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Circle 482 on page 19

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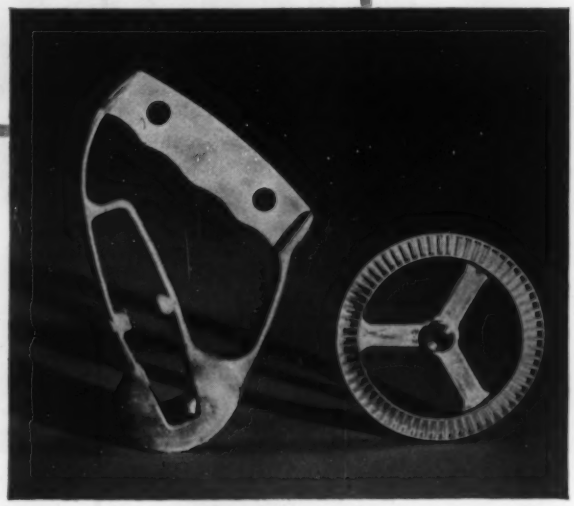
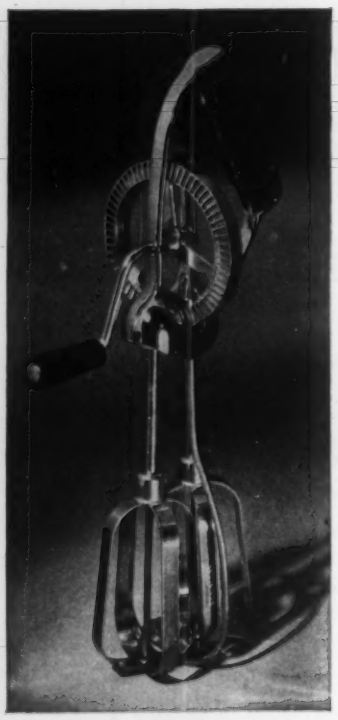


it's



ECONOMY

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LOWER PRODUCTION COST—An assembly of stampings, used for older types of beaters, require six or eight parts instead of the two ready-to-use ZINC DIE CASTINGS.

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IMPROVED APPEARANCE—The flowing, modern design and smooth finish of the castings provide a perfect base for a bright chromium plating accented by black plastic handle faces.

Any die caster will show you how these money-saving and quality-improving benefits can be applied to your products.

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MACHINE DESIGN
MAY 16, 1957

The Show Goes On

NEXT week, for four days, New York's giant new Coliseum will be host to the second Design Engineering Show and Conference. Best estimates indicate that close to one-fifth of MACHINE DESIGN's readers will be there.

National showcase for the materials and components that go into all sorts of machines, appliances and equipment, this exposition has skyrocketed in one year to a place among the nation's top five industrial shows.

As a worthy descendant of the early bazaar and market place and cousin of the time-honered state and county fair, the modern industrial exposition occupies a unique place in our economy. Unlike consumer goods, industrial products cannot, with any efficiency, be displayed in retail stores or advertised through radio, TV, general magazines and newspapers.

Thus there have grown up the technical and industrial publications—and the industrial shows. Complementing one another, each supplies something that the other lacks. The show is like a magazine come to life, dramatic and teeming with human activity. A magazine could be thought of as a show in print, for more reflective perusal in the comparative calm of office or home.

Design engineers have long needed a meeting place where they can rub shoulders with each other and with the people who furnish components and materials. The Show and Conference provide the perfect setting. Three hundred and fifty exhibitors have taken almost three acres of floor space to display their products. Thirty-three authors and conference officers under the auspices of the Machine Design division of ASME have teamed up to present a lively program with broad appeal to design engineers at all levels.

Those who attend this show will, we feel sure, return home refreshed and stimulated. And some of their enthusiasm and experience is bound to rub off on their less fortunate brethren back at the plant. By this means, and with the aid of the extensive show report which appears in this issue, the influence of the show and conference will be extended far beyond the confines of the New York Coliseum.

Colin Carmichael

EDITOR

How to plan for accurate communication in **Man-Machine Systems**

By Richard Coburn
Head, Man-Machine Section
U. S. Navy Electronics Laboratory
San Diego, Calif.

ONLY points of communication between a machine and its operator are the controls and displays provided on the machine. The operator has no way of knowing what the machine does without reference to its displays, and he has no way of influencing operation of the machine without use of controls. In effect there is a servo loop in the man-machine system which may be simply diagrammed as in Fig. 1.

The display generates signals, and the man uses these signals to evaluate error and effect the action necessary to nullify the error. If the flow of information is blocked at any point in this loop, the man-machine combination will cease to function properly.

Insofar as man's role in this loop is concerned, it is modifiable in only two basic ways: (1) training for specialized performance, or (2) selection of a particular man already having the desired set of characteristics. Rather than doing either of these, many times it is more desirable to modify the machine to make it operable by any "off-the-shelf" man—with no special selection or training requirement.

Modification of the machine to this end clearly means alteration of the information flow (rate, quantity, characteristics) as mediated by the controls and displays. Thus controls and displays are not mere appendages or circuit terminals of the machine; rather, they are integral and vital

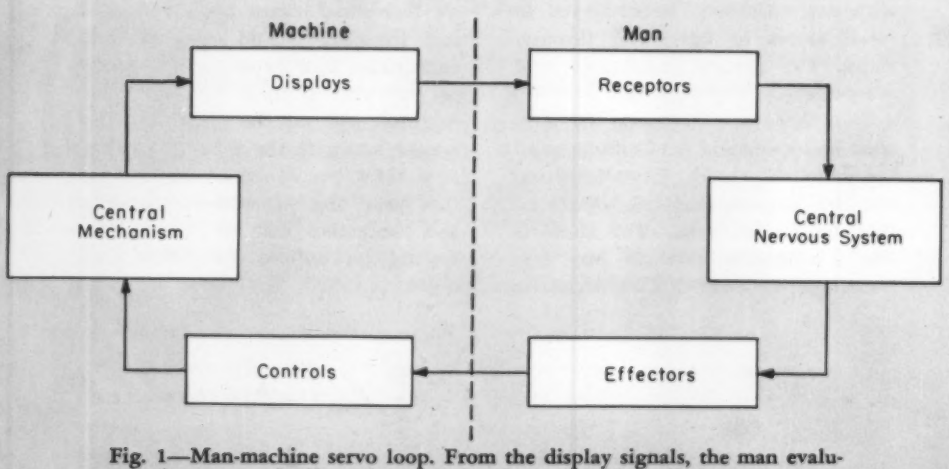


Fig. 1—Man-machine servo loop. From the display signals, the man evaluates the error and effects the control action required to eliminate the error.

Design of manual controls and visual indicators strongly influences degree of co-ordination between a machine and its operator. Here are seven rules for designing most effective arrangements:

1. **Make displays and controls compatible.**
2. **Use functional grouping.**
3. **Employ sequential arrangements.**
4. **Arrange elements according to importance and frequency of use.**
5. **Align indexes of check reading dials.**
6. **Use symmetry sparingly.**
7. **Stratify displays and controls according to function.**

components in the man-machine system.

The implications for the designer are important: he must plan his displays to be compatible with man's receptor (sense organ) and information-processing characteristics. His controls must be designed for compatibility with the static and dynamic characteristics of man's effectors (muscles and associated body members). It must be recognized, too, that each control is also a display because in manipulation of the control there is always feedback to the central nervous system. This is one reason why the relationship of controls to displays is important.

This discussion will present important principles illustrated by simplified examples to aid the designer in his control-display arrangement and panel-layout problems. The discussion will not, however, consider the arrangement of workspace into which the panels fit, nor will it directly consider the design of individual control and display elements.

Control-Display Compatibility

It is essential that controls and displays which work together be compatible with one another. The principal factor involved in compatibility is that the display must respond in accordance with the expectation of the operator as he manipulates the control. These expectations are established in the mind of the operator, not because a given relationship is fundamentally more suitable than another, but by convention and usage.

Most adults in our technically advanced society have had considerable experience with cranks, nuts and bolts, door latches and knobs, water faucets, etc., and thus have acquired stereotyped

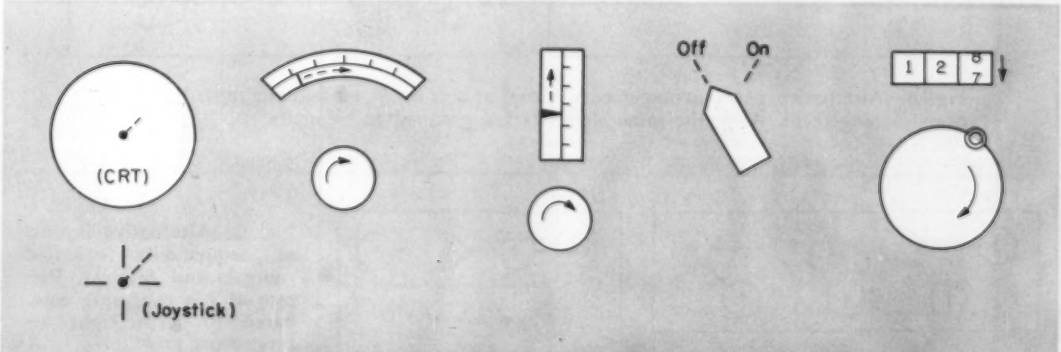


Fig. 2—Control-display relationships. These arrangements are compatible because they match the expectations of the operator.

expectations in dealing with such hardware. These expectations are unknowingly transferred to other situations requiring manual manipulation. Several classes of the generally accepted relationships are illustrated in Fig. 2.

Difficulties arise when manipulation of a control results in a display change contrary to expectation. An operator may learn to adjust to incompatible control-display linkages, but when he is put under stress, he is likely to forget his recent training and manipulate the control in accordance with his original expectation. Obviously serious errors can result under these circumstances. The principal caution to the designer is to avoid relationships which are contrary to common stereotypes or which may involve conflicting stereotypes.

Functional Grouping

On most complex equipment there will be families of related control-display units. If there are not other overriding considerations, it is desirable to make orderly arrangements recognizing the functional grouping. A hypothetical control-display requirement illustrates the principle. Assume:

1. The device is to remotely control a carriage in a shaft 100 feet deep.
2. The carriage must stop frequently at the top and bottom where it must be seated.
3. In seating, the carriage cuts off its own power by means of limit switches.
4. Occasionally intermediate stops at random points may be required.
5. The power drive for the hoist-lower motor is electronically controlled.
6. The voltage to the control unit must be adjusted to a standard value after warmup, but prior to operating the equipment.

Two plausible panel arrangements are shown in Fig. 3. Note these differences in the nonfunctional arrangement, Fig. 3*a*, and the functional grouping, Fig. 3*b*:

There are two distinct functional groups on panel *b*, one for the depth controls and displays, and the other for the power controls.

The "depth" functional grouping of panel *b* is arranged to: (1) give the depth scale a pictorial orientation, (2) associate the limit lights with the corresponding extremities of the scale, (3) orient the control pushbuttons pictorially ("stop" in the center, "hoist" up and pointing up, "lower" down and pointing down). Thus this cluster of controls is organized and internally consistent.

The "power" functional group consists of voltmeter, voltage adjustment knob, and power switch. The adjustment knob is located directly in line with the standby position on the power switch, thus relating it to this position. The "off," "standby," and "on" positions are combined on one switch, since they are functionally related, may be arranged in order of sequence, and are mutually exclusive.

Specific deficiencies of panel *a* include:

1. Separate standby and power switches are provided, thereby complicating the panel and the operating procedure.

2. The voltmeter and the adjustment knob are separated from the power switch with which they are associated. The operating procedure is made

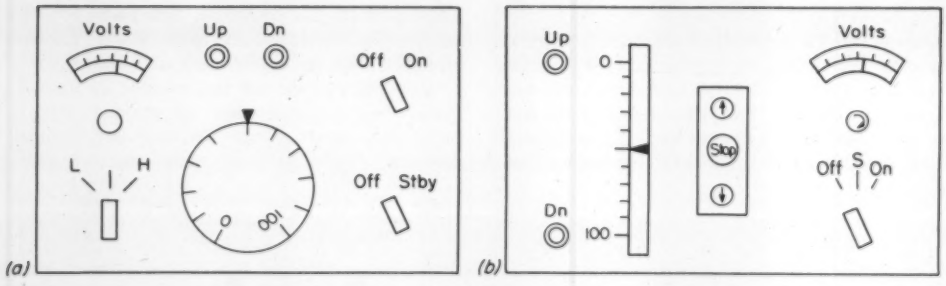


Fig. 3—Alternative panel arrangements. Panel at *a* is arranged without regard to functional arrangement. At *b*, the same elements are grouped functionally.

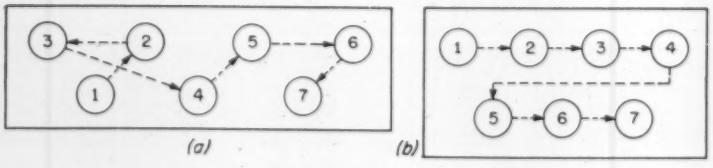


Fig. 4—Alternative layouts of sequentially operated controls and displays. Pattern at *a* is confusing compared to left-to-right arrangement at *b*.

more involved than necessary. The operator is required to shift attention between two locations on the panel; they should be at one location.

3. The depth scale is circular and hence lacks the pictorial connotation of the panel *b* depth scale. The instrument is further complicated by movement of the scale itself against a fixed index. This may give rise to ambiguous expectations on the part of the operator. (Does throwing the switch to the right increase the dial reading, rotate the dial clockwise, or what?) Thus when the operator wishes to move the carriage from the 50-ft level to the 70-ft level, he might very well mistakenly throw the switch to "hoist" rather than to "lower," simply on the basis of the confused and contradictory display pattern which is presented to him.

4. The "up" and "down" pilot lights are not pictorially related to the scale and cannot be, with this particular design. Because the relationship is not simple and direct, as with the corresponding lights on panel *b*, it is necessary to label them, and the operator must make the devious translation through verbal symbolism to relate the lights to the dial.

Thus it can be seen that in many subtle ways, the operation of panel *a* is far more involved than the operation of panel *b*.

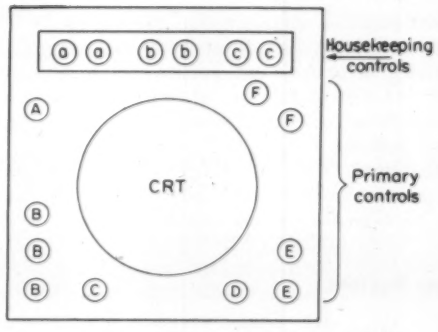


Fig. 5—Separation of controls on basis of importance and frequency of use.

Sequential Arrangement

For certain types of functions it is preferable to arrange control-display units on the basis of sequence of operations. The criterion for this type of arrangement is simple and straightforward: the operation must be performed in a definite sequence (or perhaps in alternative sequences) each time essentially without variation. Equipment amenable to this type of treatment includes certain test and checkout panels, control stations for unit manufacturing processes, etc.

Assume a situation in which there are eight control-display elements each operated in sequence. The original arrangement is shown in Fig. 4*a*. Numbers indicate order in the sequence and dotted lines show pattern of shift in attention in the operating sequence. Compare this panel with the one in Fig. 4*b*, redesigned completely on the basis of sequential arrangement. The pattern of control-display units in Fig. 4*b* makes a smooth left-right progression of attention, thereby streamlining the operating procedure.

Importance and Frequency of Use

For equipment having a number of control-display elements varying in importance or frequency of use, it may be desirable to arrange them on the basis of one or both of these factors. Thus a designer may divide his control-display elements into primary and secondary groups, and within each group he may use yet another basis of organization.

For example, in the design of radar indicators it has become common practice to separate the infrequently used ("housekeeping") controls from the more frequently used ones, Fig. 5. Within both groups control-display elements would be functionally grouped.

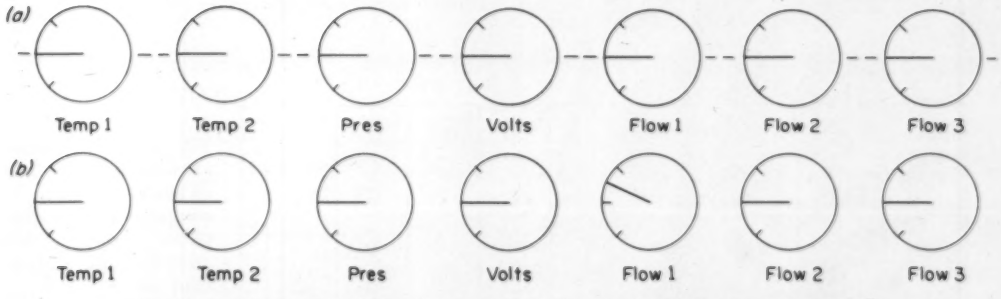


Fig. 6—Check-reading dials. At *a*, all indexes are shown in normal position. Any index off normal indication, *b*, can be quickly spotted.

The primary controls and displays are favored with preferential position, to maximize visual and manual accessibility. The secondary controls may be on a recessed panel fitted with a sliding or hinged cover to simplify the overall control-display configuration presented to the operator.

Check Reading

Instruments which ordinarily should show only standard values may be set up for check reading. When so used, the instruments are arranged so that the index of each points along the line of centers when indicating the standard value. A check-reading arrangement might then appear as shown in Fig. 6*a*.

The advantage of the check-reading arrangement is that the operator can detect at a glance any evidence of malfunctioning because any instrument off its standard value becomes conspicuous as shown in Fig. 6*b*.

Of course, if it were necessary merely to detect malfunctioning in the system, it would be preferable to use a set of binary indicators such as pilot lights. However, check-reading arrangements are used when it is not only necessary to detect the malfunction, but also to determine the direction and the magnitude of error.

Symmetry

Though one or more of the foregoing principles may largely determine the basic arrangement, there are other principles which may be considered. One of these, symmetry, deserves special mention because it is so frequently abused.

Many designers strive in planning layouts to create panels which are bilaterally symmetrical. This is unnecessary and often harmful; symmetry should be a secondary consideration after functional requirements are met. Actually a well-planned panel which satisfies functional criteria is usually also well-balanced and esthetically pleasing.

Symmetry was carried to an unreasonable extreme in one aircraft cockpit in which a pilot's major control panel was duplicated for the copilot in mirror image arrangement. This arrangement reversed the positions of the intercom and ordnance release controls, which were similar in appearance and in control action.

Thus, in trading positions, the pilot and copilot might easily become confused in manipulating these controls. Therefore, both had to be especially vigilant to avoid operating these controls as if he were in the other position (for which he was trained and which he manned on occasion).

Stratification of Function

When a number of panels of the same type are to be manned by one operator, special attention must be given both to the individual panel and the arrangement of panels. It is usually desirable in such cases to arrange panels and overall layout on the basis of stratification of function.

Assume that the problem is to design a panel arrangement for four target control units which drive a radar simulator. Each unit must contain the following control-display elements:

1. A followup control for height.
2. A climb-dive control.
3. A followup control for course.
4. A turn rate control.
5. A followup control for speed.
6. An acceleration control.

Two possible arrangements are shown in Fig. 7 for comparison. Note that with the panel in Fig. 7*b* there is a clear-cut matrix of targets versus functions (on horizontal strata). This will allow the operator to learn a co-ordinate system for the panel, making it easy for him to locate any specific control for any target. This arrangement also helps him to see the interrelationships among the instruments on the various panels.

Other Factors

In addition to the foregoing principles, the designer must, needless to say, consider a number of other factors such as the hardware available or specified, behind-panel restrictions, the work space, and environmental conditions. However, careful application of the principles discussed here should help the designer to produce good, functional panel arrangements.

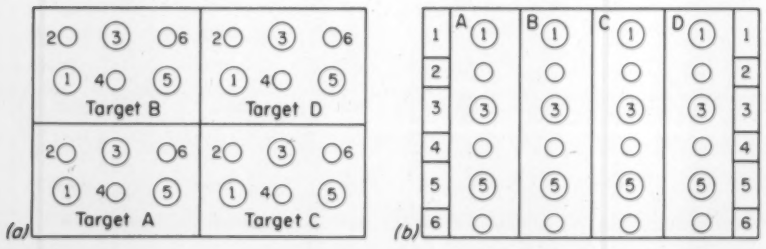
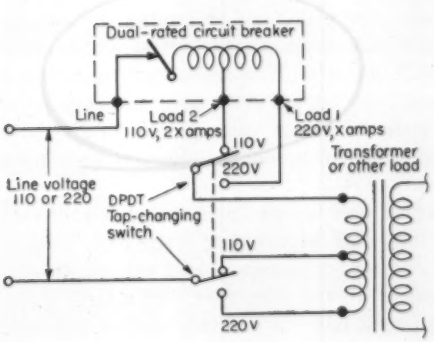


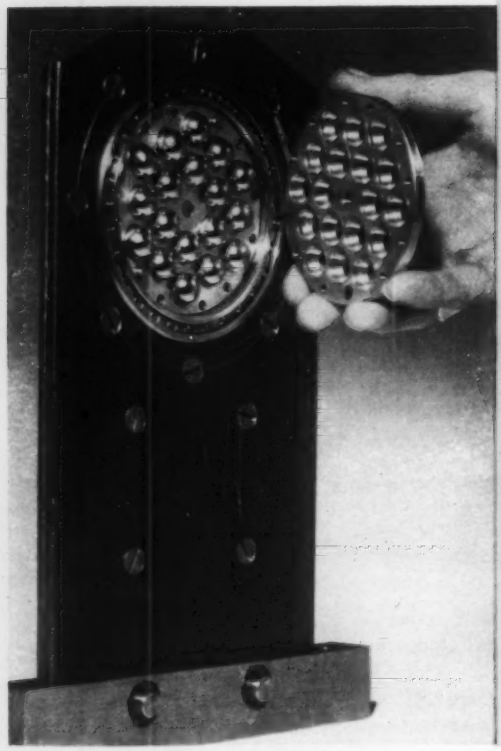
Fig. 7 — Alternative arrangements of four identical panels. Arrangement at *a* compares poorly with stratification of function shown at *b*.

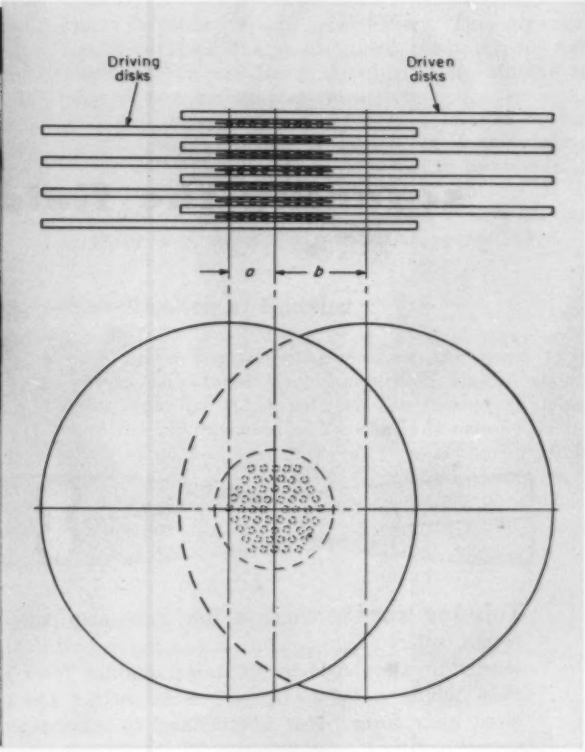
scanning the field for *ideas*

Tubular screw design for extremely long-lead requirements offers light-weight construction with high columnar strength. Developed by Clint McLaughlin, New York, screw is steel tubing rolled to figure-8 cross section and twisted to desired helix form. Nut is machined to matching cross section.

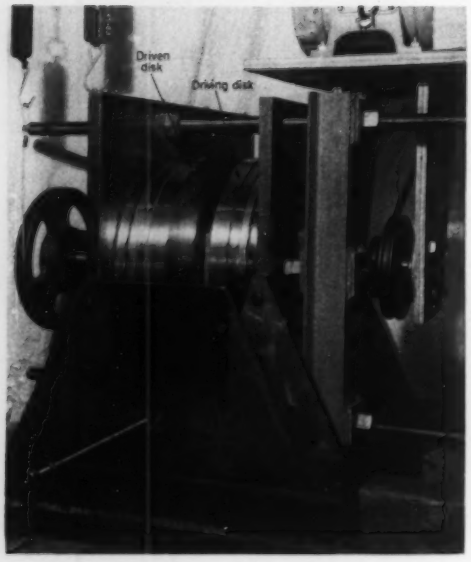
Separate load connections on the actuation coil of a circuit breaker permit multivoltage ratings in a single unit. Developed by Heineman Electric Co., the dual-tapped design has a low-voltage and a high-voltage tap plus a common tap. This circuit design permits multivoltage control in dual-voltage applications or facilitates standardization of control units when either of two voltages is used.







Galaxy of balls serves as the power transmitting element in an adjustable-speed traction drive developed for heavy-duty service. Designed by W. S. Rouverol, University of California, to provide maximum contact under load, the basic drive assembly consists of hardened driving and driven disks and a rotatable cage containing a number of steel balls. In operation, the cage is pressed between the disks with its axis of rotation in the plane of the axes of the disks. Rotation of the driving disk causes the balls in the cage to transmit rotation to the driven disk. The cage rotates at the average angular velocity of the two disks. Each ball in the cage moves at a constant speed in a circular orbit about the center of the cage, with a superimposed spinning motion that eliminates slippage on the face of either disk. Due to the multiplicity of contact points and the hardness of both disks and balls, extremely high clamping pressures may be utilized for maximum efficiency.

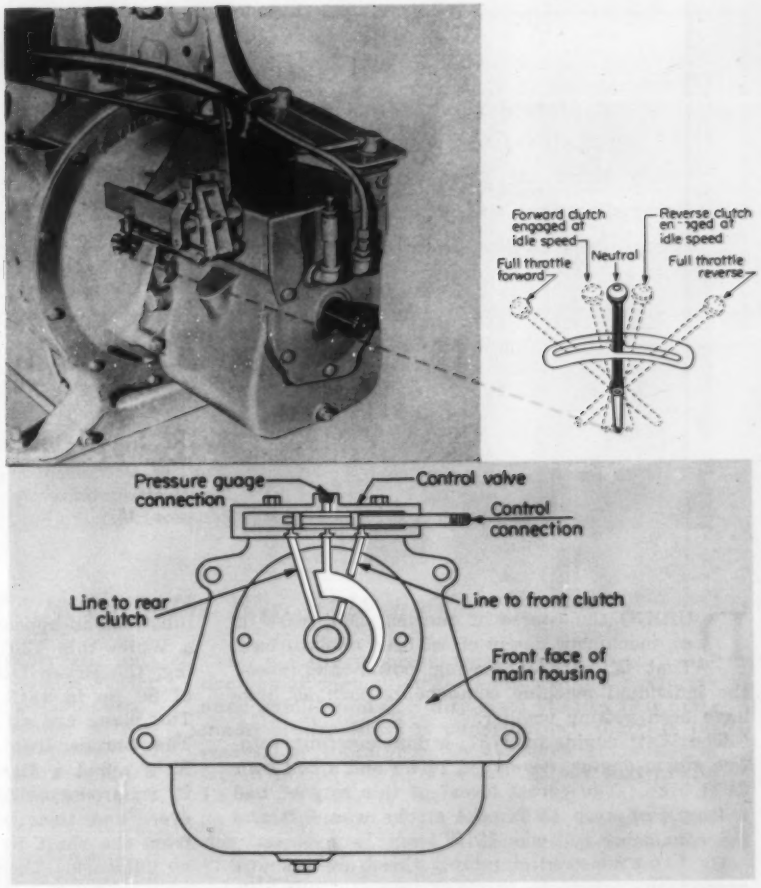


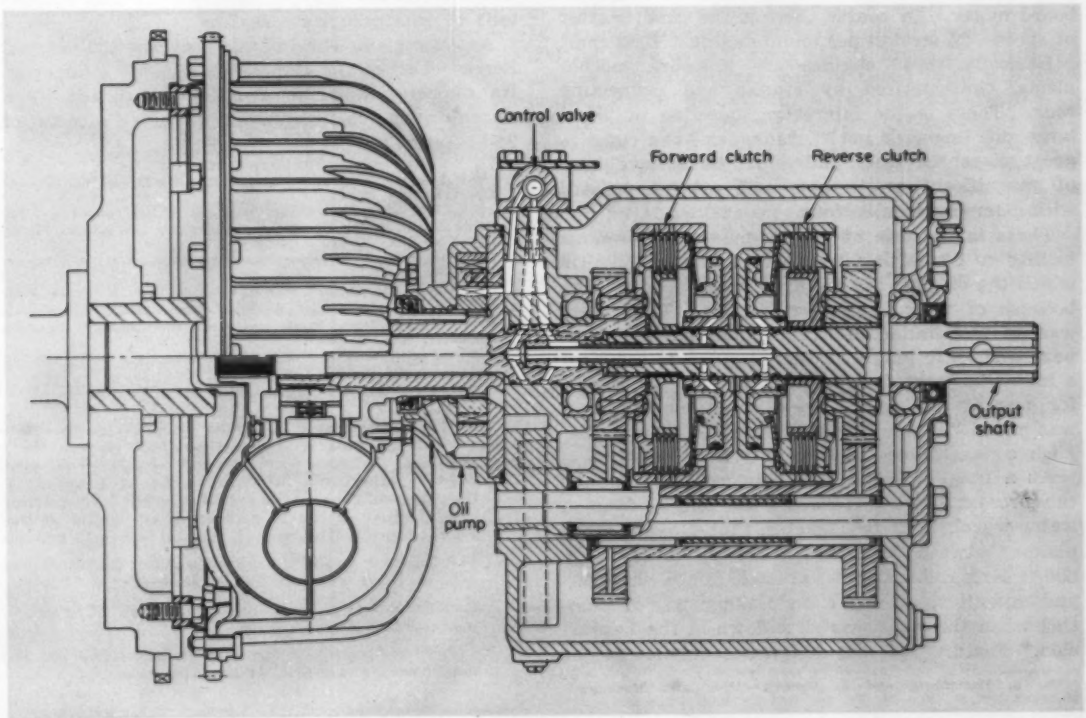
At the point where the axis of rotation of the cage intersects the disk faces, the velocities of the disks are equal and opposite. The speed ratio is thus a/b and is changed by lateral shifting of the cage or of one or both disks. Speed ratio varies from zero to infinity; top practical speed is dependent only upon input torque.

Experimental unit shown consists of one driving and one driven disk with rather large balls used in the cage. Proposed high-torque unit will incorporate numerous cages, overlapping disks, and a large quantity of very small balls to multiply contact points.

ideas

Single-lever control of drive speed and direction is provided by a combination torque converter and reversing clutch arrangement. Movement of throttle lever from neutral position on Funk Revers-O-Matic transmission activates hydraulic control valve, engaging either forward or reverse clutch at idle speed. Further movement of lever engages mechanical throttle linkage and increases speed. System permits smooth, fast acceleration without shock and complete control of speed and direction with one hand.





Most present mechanisms are masterpieces of compactness and efficiency when compared with those of past centuries. But for sheer magnificence, today can show little to surpass some of the early designs of

Giant Linkages

By R. S. Hartenberg
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DURING the course of the last 200 years or so, machinery has in effect been miniaturized. That is, with increasing power and speed the individual machine components such as links have been getting smaller.

The Watt engine of 1787, a double-acting, rotative steam engine, developed 10 hp and stood over 24 ft high. The "great lever" of this engine* had a length of over 15 ft; the stroke was 4 ft and the connecting rod was 13 ft long.

By today's power standards these are gigantic proportions, when we think of, say, a 10-hp outboard motor. Of course there is the small matter of speed—25 strokes per minute against 4000 rpm!

Basically these engines are linkwork mechanisms, characterized by cranks and connecting rods. There is the interesting question of "How large did linkwork get?" Linkages have come in great sizes; at least, individual links have been of magnificent proportions and were associated with pumping installations.

There is the tale of a mine-pump in Germany, having a connecting rod over 7200 ft long, in which the original stroke of 36 in. dropped to 7 in. because of wear in the connections. Then there was an installation in France that had a linkage nearly 2000 ft long. It was finished in 1682 for a king who wanted to have a nice fountain display for one of his girls. These creations—the last was called "A monument of ignorance" by an English commentator—live on only in books.

As a tangible connection between the past and the present there is left, on the Isle of Man, a water wheel, 72 ft in diameter, that drove a mine-pump (between 1854 and 1929) by means of a 600-ft long rod. The wheel itself is still in repair and operative, although the linkage was dismantled when the mine was shut down in the Depression. Features of this design are detailed in the illustrations appearing on the facing page.

While this 72-ft diameter appears overwhelming, the Bryan Donkin Works built a 76-ft wheel of 30 hp in 1843 for a textile mill in Florence. The plans are still on file in the London office. The Burden Iron Company's wheel (1851, Troy, N. Y.) had a diameter of 62 ft with a length of 22 ft, producing 550 hp. These two wheels, however, had their rotational power taken directly from the shaft by means of gearing. There was no linkwork. There is also a reference to an 80-ft wheel furnished a paper mill near Dublin, but details of this design are lacking.

Another giant wheel of the past was the original Ferris wheel of the Exposition of 1893 (Chicago). Its diameter was 250 ft. It was turned by a steam-driven, cast-iron spur rack with teeth of 24-in. pitch.

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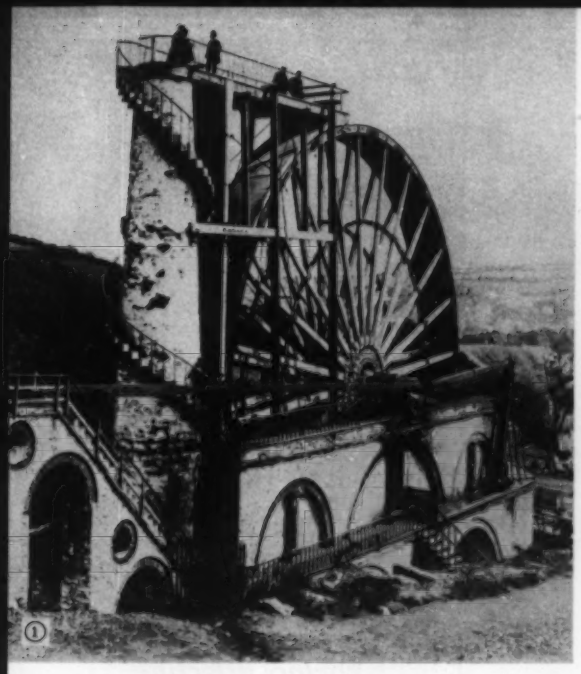
1—The Great Laxey Wheel in 1924. Water from a reservoir in the hills is led to the wheel through the tower and the decked-over, horizontal trough. The pitchback overshot wheel ran counterclockwise at a speed of less than 4 rpm. The beginning of the 600-ft connecting rod and the first of the 16 support rollers appear at the left. Photo, courtesy Director of Science Museum, London.

2—Structural masonry work to support the 600-ft connecting rod. Photo, courtesy Anders Jespersen.

3—Side elevation and construction detail of wheel. Drawing, courtesy Anders Jespersen.

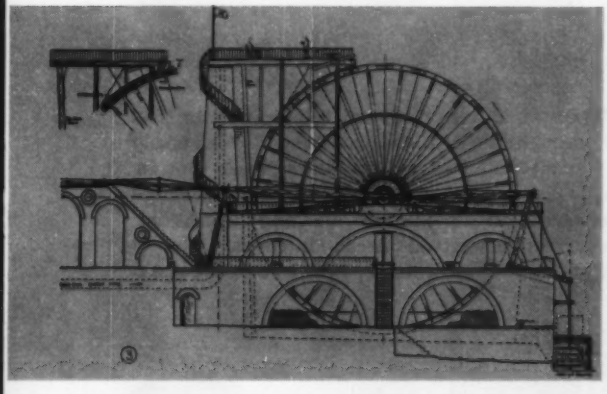
4—Side elevation and site plan of wheel and rod installation. Drawing, courtesy Anders Jespersen.

*R. S. Hartenberg and J. Denavit—"Men and Machines," MACHINE DESIGN, Vol. 28, No. 14, July 12, 1956, Page 88.



The Lady Isabella Water Wheel

A Danish engineer, Anders Jespersen, tells the detailed story of "The Lady Isabella Water Wheel of the Great Laxey Mining Company." After a first visit to the wheel, which is now run only for the "amusement of visitors," he was fascinated to the point of returning to it so that he might have opportunity to learn more of its history and dimensions.



To get the whole story, he performed a hydrological survey, stress analyses and performance calculations; if any such studies had been made at the time of construction, there is no record of them. Mr. Jespersen's comment is worth noting: ". . . it is safe to say that in the Laxey Wheel we have a superb example of . . . engineering at its best. The designer, and the builders of this Wheel had a first class knowledge of their craft and its materials."

Only one original drawing, a side elevation, is still in existence. The wheel itself is about 72 ft in diameter, and was judged capable of 200 hp. The wheel axle (17 ft long, 21 in. diameter) is horizontal and is fitted with a 5-ft crank. From the crank, a line of oak beams 600 ft long transmitted the driving power to a bellcrank at the mineshaft, where a 2240-ft long pumprod was given a (nearly) vertical stroke of 7.5 ft. The "long beam" was supported by 16 rollers on top of a masonry structure resembling an old Roman aqueduct. Massive counterweights (8-10 tons) here and there served to keep the linkage system taut—preloading for antibacklash.

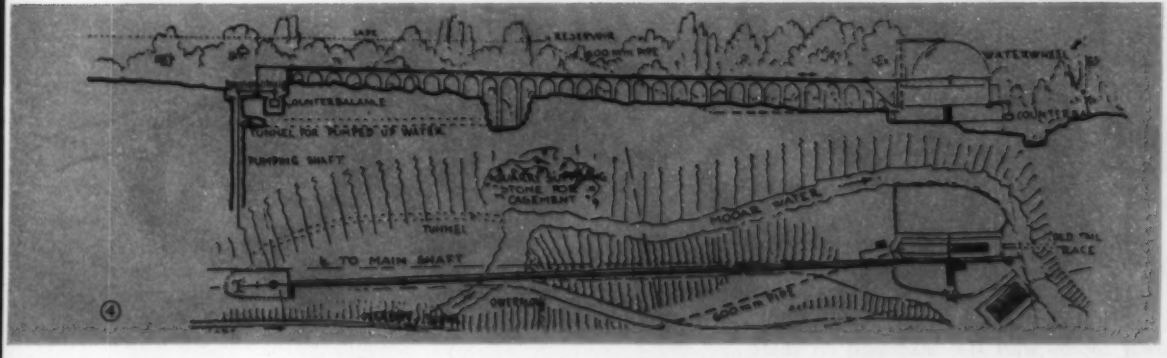


Fig. 1—Subfractional-horsepower servomotor in a 1½ in. diameter frame size. Induction motors in this size can develop 1/600-hp on 60-cycle current or 1/150-hp on 400 cycles. Minimum and maximum applied voltages permissible are 26 and 115, respectively.

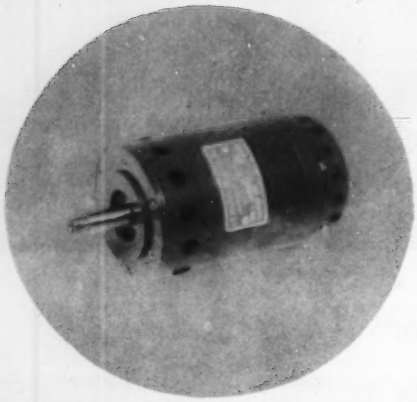


Fig. 2—Self-cooled, subfractional-horsepower, induction motor with nonstandard threaded shaft. A wide range of power outputs can be designed into this 2-in. OD frame ranging from 1/15 to 1/600-hp. Drives can be designed in this frame for about any frequency from 50 to 1000 cycles.

Factors affecting

Subfractional-

By Morris Rothenberg
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THE rapid trend toward miniaturization has brought forth a great demand for extremely small-size, subfractional-horsepower motors, Figs. 1, 2, 3. Design applications for these small-horsepower drives include indexing operations, timing, remote control, forced-air cooling, etc.

Often, subfractional-horsepower motors are speci-

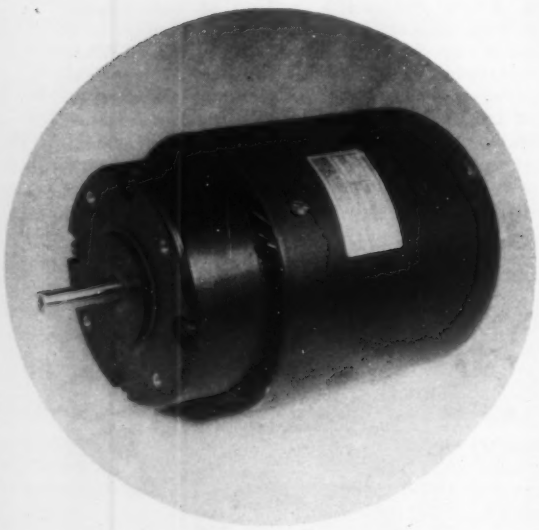
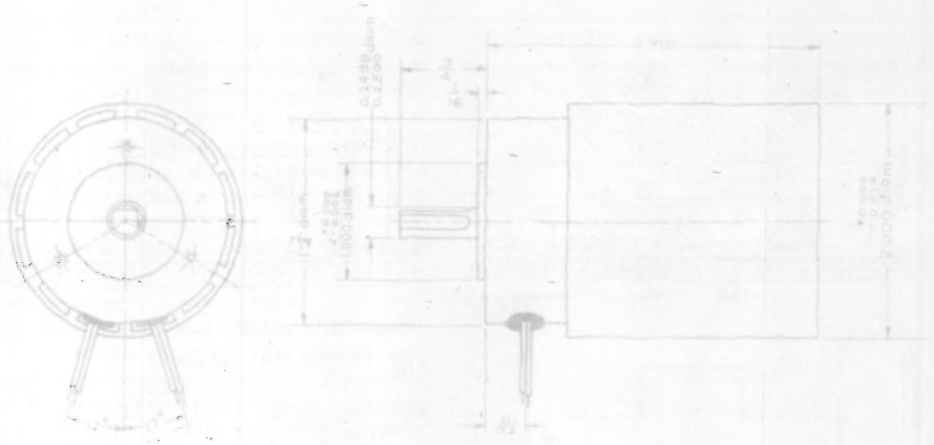


Fig. 3 — Self-cooled, subfractional-horsepower motor with flat machined on shaft. Frame OD is 3⅞ in.



selection and application of

Horsepower Motors

fied not because a low-horsepower drive is particularly desired, but rather, because of strict motor-space limitations. The horsepower output of these small units is quite low at best, even in the most efficient designs. For this reason it is quite important to supply motor manufacturers with all the information obtainable about the equipment in which a motor is to be applied plus detailed data on its operating environment.

This article discusses a number of mechanical and electrical design modifications possible in ac subfractional-horsepower motors without having to resort to high-cost special designs.

General Design Considerations

It is often possible to obtain custom-like design features in a motor for special applications by simply modifying or redesigning from a basic frame size. To do this, exact and complete data about the application are a design must.

Important factors to evaluate initially are space available for motor, load or output-power require-

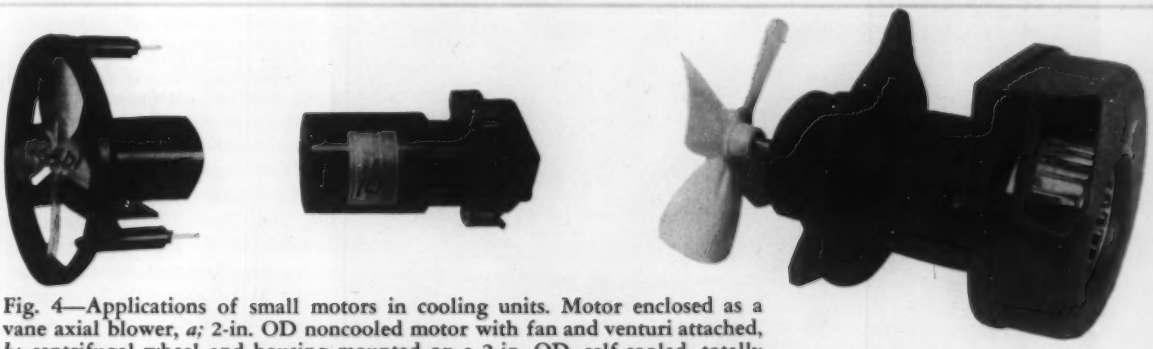


Fig. 4—Applications of small motors in cooling units. Motor enclosed as a vane axial blower, *a;* 2-in. OD noncooled motor with fan and venturi attached, *b;* centrifugal wheel and housing mounted on a 2-in. OD, self-cooled, totally enclosed motor, *c;* and a 2-in. OD self-cooled motor with fan, blower housing, wheel and special bracket attached, *d.*

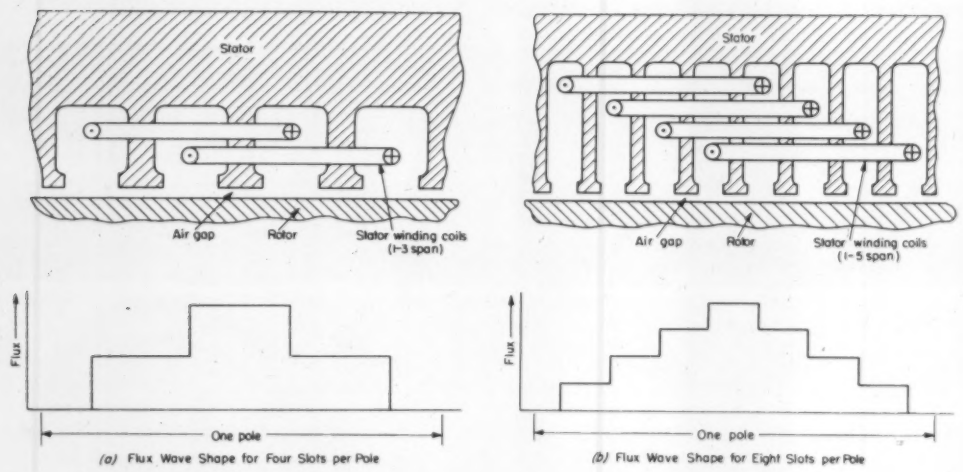


Fig. 5—Stator design with few slots per pole, *a*, develops greater motor losses because the shape of magnetic flux pattern is distorted more than designs with many slots per pole, *b*.

ments and the type of input power available—ac or dc, voltage magnitude and frequency. These factors help determine the external configuration of the motor, design and production time, and cost. If it weren't for the space and weight limitations encountered in certain applications, there would be little need for the subfractional-horsepower motor. It would be possible to select a fractional or integral-horsepower motor to perform the required job. But since subfractional-horsepower motors must usually operate within a small space, the design of every component must be for optimum operation for a specific set of electrical and mechanical conditions.

Motor Speed: Maximum power output within the allowable space depends directly on the motor lamination design and winding distribution. Power output is a function of speed, and speed is a function of frequency and the number of poles per motor phase.

Theoretically ac induction motors are limited in their maximum speed by their number of poles and line frequency. Their maximum speed is given by

$$S = \frac{120f}{p}$$

where f = line frequency, cycles per second; p = number of poles; and S = theoretical maximum speed, revolutions per minute. For example, if the power frequency is 60 cycles per second, then

Fig. 6—Typical fractional-horsepower stator design in a 3 5/16-in. OD.

a two-pole motor will have a theoretical maximum speed of 3600 rpm; a four-pole, 1800 rpm; a six-pole motor, 1200 rpm; etc. Motor speed selected will depend on the application, of course. For example, in air-cooling devices desired motor speed will depend on the type of impeller selected to give the required volume of air per unit time. As shown in Fig. 4, subfractional-horsepower motors are used to drive axial fans, vane-axial blowers and centrifugal blowers.

Copper-to-Iron Ratio and Motor Efficiency: Harmonics distort the magnetic flux pattern and create unnecessary losses in a motor. Therefore, for maximum efficiency, induction motors are usually designed with laminations having as many slots per pole as practical to minimize the effects of harmonics. Fig. 5 shows that a stator lamination designed with many slots per pole produces a closer approximation to an ideal sine-wave shape than a lamination with a small number of slots per pole, which produces a marked square-wave effect. A typical stator illustrating slot design is shown in Fig. 6.

There is a practical limit to the number of slots that can be used. When too many slots per pole are used, a point is reached where the insulation required in the slot reduces the total amount of copper that can be used per slot because of space limitations. Consequently, the increased efficiency that can be achieved with a greater number of slots is counteracted by loss of efficiency caused by a decrease in the amount of copper that can be used in relation to the steel.

Number of turns per winding depends largely on the application. The smaller the copper-to-steel ratio, the smaller will be the cross-sectional area of the copper, and the greater will be the copper resistance of the winding. As winding resistance increases, efficiency is decreased accordingly. Therefore, a motor is usually designed with the objective of keeping harmonics at a minimum and copper content at a maximum.

Rotor and Stator OD: Ratio of the rotor OD to the stator OD is another important design consideration. Effect of decreases in the rotor-diameter to stator-diameter ratio on the shape of the characteristic speed-torque curves is shown in Fig. 7*a*. Selection of rotor and stator diameters, therefore, is largely determined by the application. For example, if a motor is to be used in subzero temperatures, then obviously a high starting torque will be necessary to overcome the high viscosity of bearing grease. The curve selected might look like Fig. 7*a*, curve *C*. In another case, if the motor is to drive an air impeller which must give proper cooling for a wide range of altitudes, as in aircraft electronic equipment, curve *B* in Fig. 7*a* might be selected. Such an application would require a high-slip motor whose speed will increase with elevation so that cooling remains relatively constant, even though the air density is reduced. The two fan-load

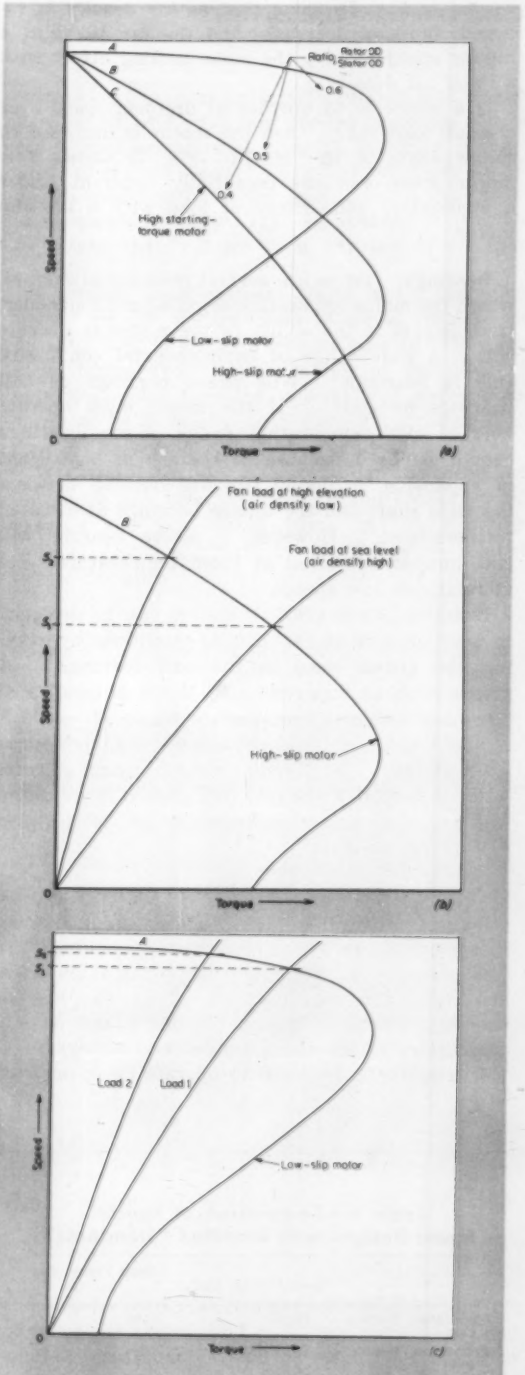


Fig. 7 — Chart showing effects of ratio of rotor OD to stator OD on shape of characteristic speed-torque curves in single-phase motors, *a*. With a high-slip motor, fan speed increases considerably, which is usually required, as air density decreases, *b*. Low-slip motor speed-torque curve varies only slightly with a rather wide change in load, *c*.

curves in Fig. 7*b* show that as air density is reduced, fan-load decreases and the fan turns at a higher speed to give the same cooling effect with a lower air density.

If a motor is to operate at uniform speed over a small load range, then the motor is designed to follow curve *A* in Fig. 7*a*. Fig. 7*c* shows how motor speed remains essentially constant under a moderately wide range of load with a low-slip motor.

Bearings: There are several mechanical factors, which the motor application engineer must consider, that determine the ability of the motor to operate within a wide range of environmental conditions. One is bearings. Will sleeve bearings or ball bearings be used? If the motor must operate over a wide temperature range, sleeve bearings cannot be used because of their high coefficient of expansion. Sloppy fits will develop between the steel shaft and the bronze bearings at elevated temperatures. However, a sleeve bearing will give quieter operation at room temperatures and at relatively low speeds.

BEARING LUBRICATION: Motors can be designed to meet unusual environmental conditions by varying the grease used in the ball bearings. A grease such as Supermil ASU-M-100 is capable of operating within a temperature range of − 100 F to 400 F although it is not suitable for high-speed applications. For temperatures ranging from − 67 F to 250 F, Beacon-325 grease is indicated for practical speed applications up to perhaps 24,000 rpm or more.

Corrosive Environments: For highly corrosive atmospheric conditions, a stainless-steel bearing is commonly used. Stainless-steel bearings are also ideal for high-temperature applications since, at elevated temperatures, atmospheres that are not normally corrosive become corrosive and have a destructive effect on chrome-steel bearings.

If a motor is required to operate in an environment where there will be an occasional salt-water splash, such as certain applications for the Navy, then the housing should be totally enclosed and the bearings should have silicone seals to prevent the water from entering the bearing.

Table 1—Comparison of Special Motor Designs with Modified "Standards"

	Special Motor Design	Basic Frame Size Modified
Lamination Tooling Cost	High	None
Production Tooling Cost	Depends on motor	None
Housing Tooling Cost	High	None
Design Time	Long	Short or none
Development Time	Long	Short
Efficiency	Excellent	Adequate to excellent
Physical Size	Very small	Slightly larger than custom designs
Time for Delivery of Prototype	Long	Short
Time for Delivery of Production Units	Long	Short
Field Reliability	Unknown	Known from similar units

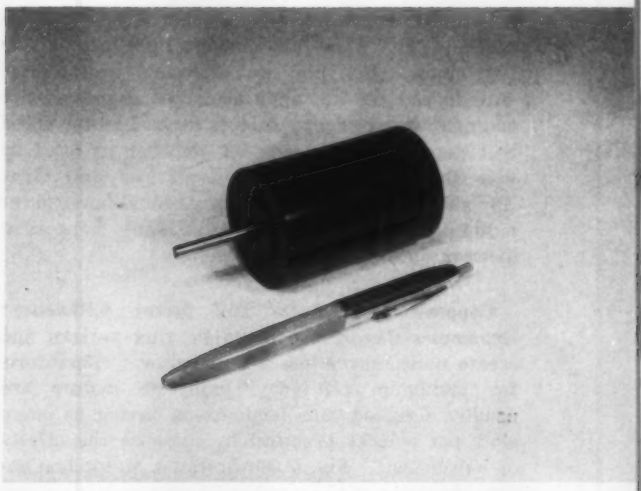


Fig. 8—Noncooled 1¾-in. OD motor with extra-long shaft-extension design. Horsepower ratings in this frame diameter vary from 1/300 to 1/60 depending on line frequency and frame length.

High Temperatures: For high-temperature applications, the type of insulation used throughout the motor for wiring, slot cells, and impregnation is an important consideration. For example, a Teflon-coated magnet wire, Teflon slot insulation and nonorganic silicone impregnating varnish for Class H service can be specified. For low-temperature applications, or Class A service, Formvar-coated magnet wire, fish paper or cambric insulation and an organic varnish is sufficient.

Special Motor Designs

The major drawbacks in having a motor completely and specifically designed for a particular application are high cost and the time required. An entirely new housing and laminations for the rotor and stator would have to be "designed from scratch." Tooling costs for these being fairly high, could not be justified unless the product using this motor is produced in extremely large quantities. For example, lamination tooling costs for a subfractional-horsepower motor may run in the order of $9000, and dies for the housing as high as $5000. These costs do not include the design time involved. Of course, it may take several weeks to obtain housing and lamination dies.

Furthermore, suppose a designer who needs a cooling motor does not know the exact amount of cooling his equipment may require until it has been designed and a prototype built. When the equipment is packaged, he may then find that the

ambient temperature within the enclosure is too high for optimum operation of its component parts. The designer is then ready to determine exactly how much cooling air will be required to reduce the ambient temperature inside the equipment. This means a motor is needed quickly. To obtain a workable motor, starting with a custom design, would mean considerable delay in the manufacture of the equipment.

Modifying Basic Frame Sizes

Rather than request a custom-designed motor, it is often better for the designer to specify a

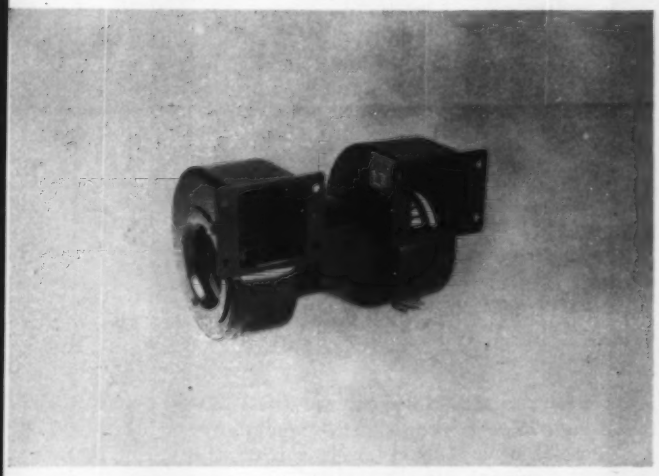


Fig. 9—Two blower housings and blower wheels mounted on a 2-in. OD noncooled motor designed with a special motor-mounting bracket.

motor that can be modified from a basic frame size. In Table 1 is a comparison of design and application characteristics of special motors and designs modified from basic frame sizes.

Frame-Size Selection: Motor manufacturers usually have several basic frame sizes from which to choose. By design, motor performance within a certain frame size can be made to meet almost any particular load requirement. It is often possible to use any one of several different rotor and stator designs—squirrel-cage induction, synchronous hysteresis, synchronous reluctance, etc.—in a given frame size. In general, for a given frame diameter, motor horsepower can be increased by increasing line voltage or frequency, or by making the motor frame longer. For special applications, the maximum horsepower rating given for a particular frame size can often be exceeded.

Mechanical Modifications: In most subfractional horsepower motors, innumerable physical or mechanical design modifications are possible at little or no extra cost. Threaded shafts, Fig. 2, shaft extensions, Fig. 8, mounting dimensions, lead length, location of lead exits and special brackets, Fig. 9, are typical examples of mechanical design changes that are easy to supply. Another relatively simple design modification is the addition of a gear train to a standard motor, Fig. 10, making it possible to obtain speeds down to a fraction of an rpm.

Electrical Modifications: Most motor manufacturers supply motors with a great variety of modifications in electrical characteristics within the same frame size. For example, a two-pole, ac induction motor operated on a 60-cycle source runs at about 3450 rpm. In a four-pole design, 1725 rpm is the normal speed of operation.

WINDING DESIGNS: Motors can be designed for about any practical voltage and frequency by varying the number of turns in the winding. Voltage, frequency, turns and field flux are related by the formula

$$V \approx KfN\phi$$

where V = applied voltage, volts; K = constant;

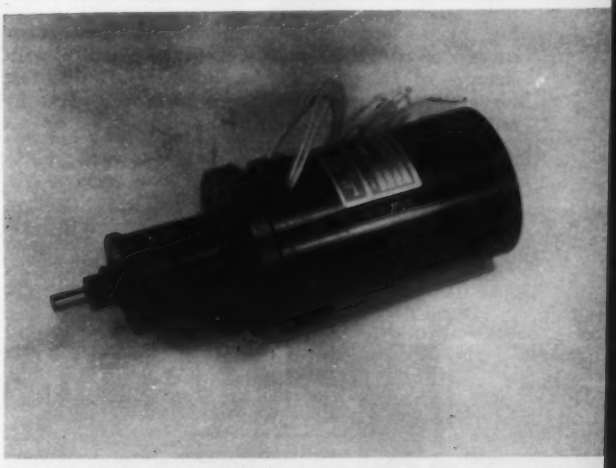


Fig. 10—Gear train attached to a 1¾-in. OD motor.

f = line frequency, cycles per second; N = number of turns per phase; and ϕ = flux per phase. The winding configuration can be set up for one, two or three-phase operation which, of course, depends entirely on the power-supply phase specifications.

ROTOR DESIGNS: Changing the number of turns in a winding has no effect on the ratio of motor starting torque to motor running torque. This characteristic is controlled by type of material used in the rotor. For example, in a squirrel-cage motor, the speed-torque characteristic produced by a given motor can be varied to give a desired torque at a particular speed or horsepower value by varying the type of copper alloy

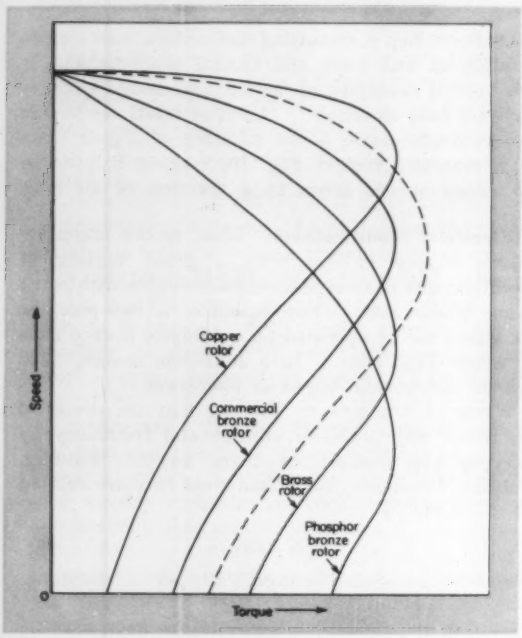


Fig. 11 — Variations in characteristic speed-torque curves of single-phase squirrel-cage motors with changes of copper alloy in the rotor. Dashed-line curve shows change in commercial bronze curve by reducing turns in winding.

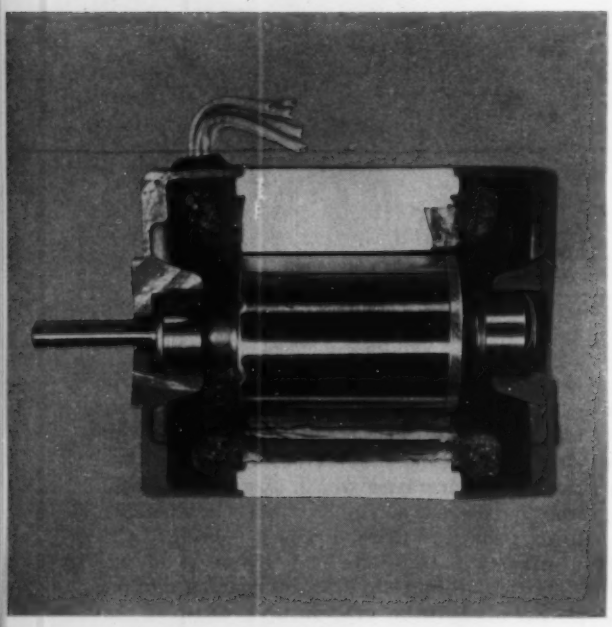


Fig. 12—Synchronous type subfractional-horsepower motor. This noncooled design employs a cobalt core and has a 3 5/16-in. OD.

used in the rotor. These variations can result in a high-starting-torque motor for operation at subzero temperatures, a high-slip motor for operation through a wide range of altitudes for cooling applications, or a low-slip motor for relatively constant speeds.

Fig. 11 shows the variation of the speed-torque curve as the rotor-bar copper alloy is changed. Variation of the rotor-bar copper alloy changes the resistance of the rotor itself because the different alloys vary in electrical conductivity. If pure copper is considered to have 100 per cent conductivity, then commercial bronze is approx-

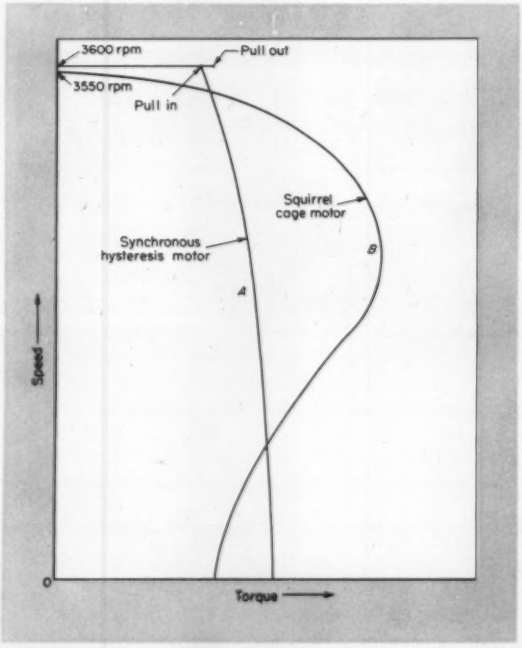


Fig. 13—Comparison of squirrel-cage and synchronous motor speed-torque curves.

imately 40 per cent conductive, brass is approximately 25 per cent conductive, and phosphor bronze is approximately 15 per cent conductive.

With the increase in rotor-bar resistivity, the curves shift downward, as shown, with the peaks remaining at approximately the same level. Also, starting torque increases as the resistivity of the rotor bars increases.

An entirely different speed-torque characteristic curve can be produced by using a rotor made of cobalt steel, Fig. 12. The motor now becomes a synchronous hysteresis type, and its speed-torque characteristic curve appears as curve *A* in Fig. 13. Curve *B* in Fig. 13 is a standard squirrel-cage type curve. The characteristics of a synchronous hysteresis motor are uniform synchronous speed (maximum possible theoretical speed) for a wide variation of load.

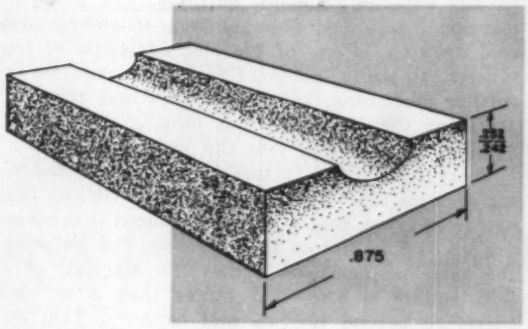


Fig. 1—Section, of C1020, is hot extruded and cold drawn to final tolerance of 0.003-in.

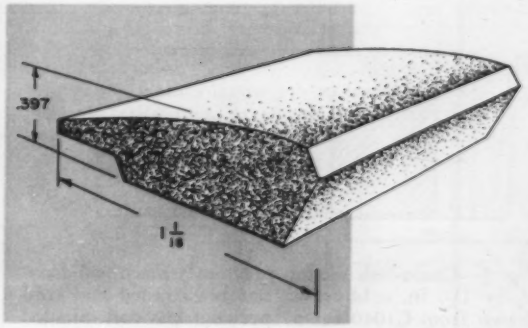


Fig. 2—Special cam section is extruded to within 0.003-in. tolerance from C1125 steel. Stress relieving eliminates strain or warpage from cold drawing.

Designing steel shapes for

Hot Extrusion and Cold Drawing

By R. L. Hugo
Cold Finished Bar Products Div.
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Pittsburgh

COMBINING the process of hot extrusion and cold drawing permits production of steel bars with intricate shapes and close tolerances. Until recently, the hot extrusion process was confined to the softer metals: lead, copper, aluminum and magnesium. However, the technical manufacturing problems associated with the hot extrusion of steel have been solved and the process is available for commercial use.

It would be an exaggeration to say that the process is either fully developed or fully exploited. There is still much developmental work to be done in the basic process. However, by combining with cold drawing, it offers a solution to many design problems. Continuous bars produced by combining hot extrusion and cold drawing offer definite economies in producing certain intricate shapes. Dimensional accuracy and surface finish are excellent, frequently requiring no further machining or finishing. The designer can employ cross-sections which machining costs may have caused to be impractical.

In general, it is possible to extrude any steel that can be rolled. In addition, some of the steels and semisteels that cannot be rolled can be hot extruded. Superalloys, titanium, zirconium and other special metals are being successfully extruded. Hot extrusion is a specialized tool which can be used to the greatest advantage for:

1. Processing materials that cannot be rolled or are very difficult to roll.
2. Producing small quantities insufficient to warrant setting up a mill. This application is becoming more important.
3. Executing rush orders when the quantity is limited. An extrusion press is very versatile and can be set up in a short time if dies are available. If the dies are not available, the time needed to make these dies is relatively short compared to the time required for rolling-equipment tooling.

Steel extrusions have high surface quality and good mechanical properties. In some cases, these are superior to those obtained in other wrought forms. Extrusions normally have a high order of homogeneity and less directionality than rolled sections, with transverse properties being practically equal to longitudinal properties. Internal quality can be very good and the extruded surfaces are

Optimum shapes that are impractical or excessively expensive to machine from bar stock may be ideal for this versatile process. Many intricate shapes can be produced with high accuracy and surface finish. Design criteria, typical parts and cost studies are given as a guide for the designer.

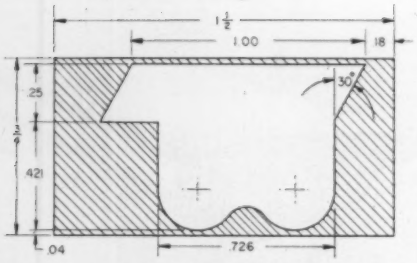
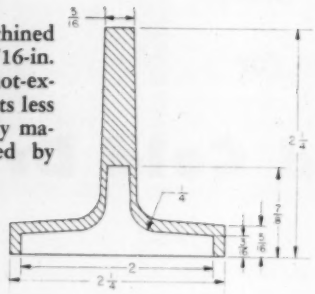


Fig. 3—Chain-link section previously machined from ¾ by 1½ in. cold-drawn flat is extruded and cold drawn from C1040 for 57 per cent less cost. Shaded portion indicates material which was previously removed by milling.

Fig. 4 — Previously machined from 2½ by 2½ by 5/16-in. hot-rolled T-section, hot-extruded shape costs 22 cents less per ft. Material originally machined away is indicated by shading.



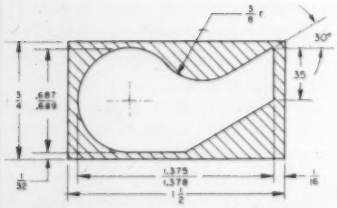


Fig. 5—Oil-hardening tool-steel pawl was originally produced from hot-rolled flat stock by one grinding and four milling operations. Close tolerances and slow milling speeds required by tool steel enabled part to be extruded and cold drawn for less than half the final cost of machined section.

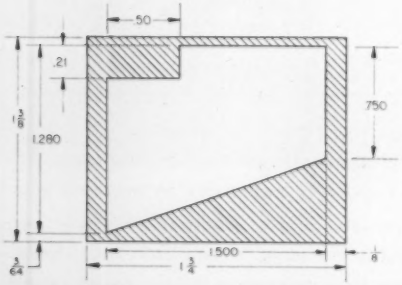


Fig. 6—Printing-press bar must be straight and free from twists for 6-ft length. Part was machined from 1⅜ by 1¾ hot-rolled flat to avoid warpage that would occur if machined from cold rolled. By hot extruding, cold drawing, and stress-relieving, satisfactory parts are produced at a 37 per cent saving.

usually superior to rolled surfaces. The close dimensional accuracy, obtained with extruding plus cold drawing, is one of the characteristics of the process. In many instances the shape requires no further machining. In most applications the only operation that is required is cutting the bar, as supplied by the mill, into the proper lengths.

There are various factors to consider in designing sections that can be hot extruded. On the J&L extrusion press, shapes can be produced that measure up to 3 in. across the extremes. For example, the extreme dimension across the diagonal of a 3-in. square is somewhat larger than 3 in. and therefore beyond present mill capacity. This capacity will vary as the size of the extrusion press varies; greater press tonnages permit larger sections to be produced.

Also to be considered is the practical minimum size that the mill is able to produce economically. At present, sections weighing no less than ¾-lb per ft, or approximately the same weight per foot as that of a ⅝-in. round, should be considered. Experience has shown that sections within these limits are most practical for production. Here also the minimum becomes greater as the press tonnage increases.

As for the shape factor, hot extruding and cold drawing is most advantageous for sections that involve irregularities of the surface or periphery of the bar and have shallow radii. These configurations are costly to produce by machining, and extruded shapes frequently show substantial savings.

While it is theoretically possible to extrude any shape for which a die can be made, there are some practical limitations, such as very sharp fillets, thin fins, and narrow, deep slots. However, by a combination of hot extruding and cold drawing, the variety of sections obtainable is substantially broadened.

Extruded and cold-drawn sections are accurate to a tolerance generally accepted for conventional

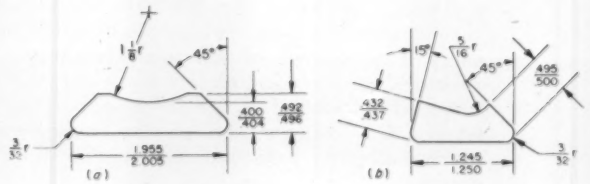


Fig. 7—Textile-machine apron guide bar demonstrates design development. Shape was originally furnished as hot-rolled cold-drawn section, *a*. Experimental extruded section, *b*, lead to complete redesign of part. Customer requested quotation on new design, *c*, which evolved into final, practical shape being furnished, *d*.

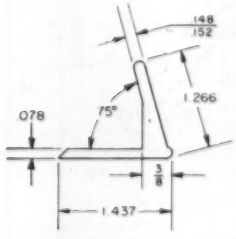
cold-drawn bars and flats. For instance, the sections shown in Figs. 1 and 2, furnished in grades C1020 and C1125, would be produced within a tolerance of 0.003-in. all over. Even finer limits of accuracy are sometimes possible.

An analysis of some representative parts reveals substantial savings over machining from the bar. Chain links, Fig. 3, originally machined from rectangular cold-drawn flat bars, are furnished to final shape by hot extrusion. Requiring only cutting from the bar, the links are now made at a saving of 57 per cent. Another part, Fig. 4, machined from hot-rolled T-section bars, was hot extruded for a saving of 22 cents less per ft.

Materials with low machinability ratings can be readily extruded. Fig. 5 shows a pawl, originally milled from hot-rolled bars of oil-hardening tool steel. By using a hot-extruded and cold-drawn section, costs were reduced by half.

Long parts requiring machining, Fig. 6, are usually made of hot-rolled bars because the stresses present in cold-rolled bars result in considerable warpage during machining. Such parts can be hot-extruded, cold drawn, and stress relieved. In the part shown, this resulted in straight, nontwisted bars at 37 per cent less total cost than machined hot-rolled bars.

The design development of a typical part produced by hot extrusion is illustrated in Fig. 7. An apron guide bar, *a*, was furnished as a hot-rolled, cold-drawn special section for many years. However, the customer felt that the performance of his machine could be improved with changes in the apron guide-bar function. To test some ideas, they investigated the possibilities of an extruded and cold-drawn special section, *b*. One hundred feet of this section was furnished at a price of 94 cents per lb, considerably less than they could obtain the material for in any other manner. After trying this shape on one machine, they obtained 14,000 lb at a cost of 36 cents per lb. This material was fabricated and put in operation on



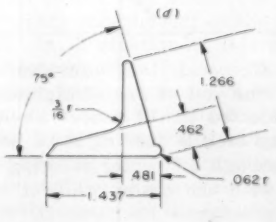


Fig. 8—Maximum leg-length to thickness ratio is 7:1. Taper, as shown by dotted line, prolongs die life.

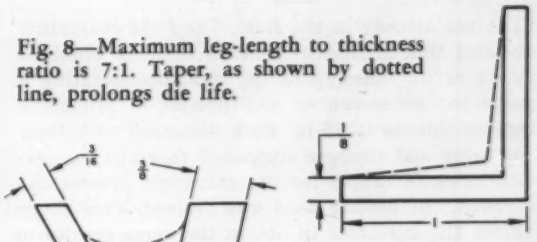


Fig 9—Acute-angle re-entrant shapes cannot be produced. Dotted line indicates practical design as dictated by die requirements.

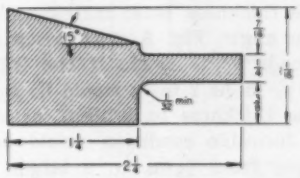


Fig. 10—Fillet radii should be 1/32-in. minimum to avoid excessive die wear.

Fig. 11 — Because of rapid die wear at shaded points, deep slots in part are impractical to extrude.

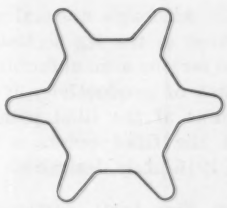


Fig. 12 — Well-proportioned part is ideal for extrusion process.

Fig. 13—Shape is typical of finned parts being produced on production basis.

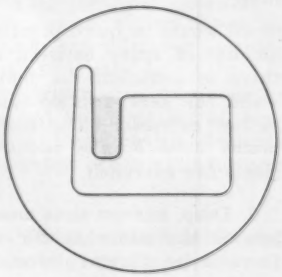


Fig. 14—Shaded area of extrusion die would break off or erode rapidly. Part should be redesigned to avoid deep, narrow slot.

machines already in the field. The field evaluation revealed that additional benefits could be obtained by an entire redesign of the unit, necessitating a guide bar as shown at *c*. Problems in producing legs as thin as 0.078-in. were discussed with their engineers and changes suggested to make the section more favorable for the extrusion process. As a result, the section at *d* was evolved. This shape allows the customer to obtain the same results in their units with only slight additional weight.

Design Criteria

Certain pertinent facts must be considered when designing parts for hot extrusion.

1. Wall thickness must be no less than ⅛-in. and preferably 3/16-in. As height of the wall increases, the thickness must increase also. As an example, an angle, Fig. 8, with a leg 1 in. long could be made ⅛-in. thick. If the leg were extended to 1½ in. or 2 in. it would be necessary to increase the thickness to 3/16-in. or even ¼-in. The most desirable condition would be to have the leg taper from ⅛-in. to a larger dimension at the apex of the angle as shown by the dotted line, Fig. 8. This taper causes much less restriction of material flow during the extrusion operation.

2. Small acute angles are not a desirable configuration for steel extrusions. The 40-degree angle in Fig. 9 could not be produced if it were necessary to form the apex. However, it would be quite practical to produce the 40-degree angle for a short distance, as shown by the dotted line.

3. Although unequal mass distribution, as illustrated in the leg sections in Figs. 8 and 9, is not too serious a manufacturing problem, from a standpoint of productivity it is better to have a small radius at the fillet points. Fig. 10 is an example. At the fillet points a minimum radius of 1/32 to 1/16-in. is desirable.

4. Fine tooth sections must be avoided due to the rapid erosion of the die material at the point of formation of the space between the teeth. Fig. 11 shows an example of a tooth design that would cause rapid die wear. The shaded area on the die is the place where die wash-out would occur.

However, a section such as is shown in Fig. 12 or 13 would be quite practical due to the generous amount of space between the teeth. As a result, there is sufficient die material present to withstand the heat, friction and pressure encountered in hot extrusion. The heat encountered approximates 2300 F, the temperature at which most steels are extruded.

5. Deep, narrow slots must be avoided. The problem is the same as for narrow tooth spacing; there is insufficient die material to withstand the forces produced in the process. The shaded area in Fig. 14, an extrusion die, illustrates the portion of the die which would break or erode rapidly. As an empirical rule, a slot must be three times as wide as it is deep and should have a generous radius at the two bottom fillets.

With these design limitations in mind, it can be reasonably assumed that a designed section can be readily fitted into the process.

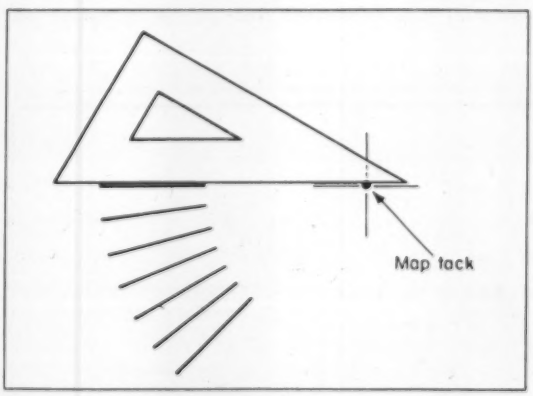
Of importance to the design engineer is the fact that a large-tonnage order is not necessary to secure an extruded and cold-drawn special section. Quantities ranging as low as 80 lb have been produced. Generally, of course, the large quantities result in price benefits.

If delivery time is important, it should be remembered that sections requiring unusual steel grades involve the procurement of special billet stock. The more commonly used grades are normally stocked at the extrusion mill. These usually include C1015, C1018, C1020, C1040, C1045, C1050, SAE4130, 4340 and 8630 and several others.

Tips and Techniques

Drawing Radial Lines

In the layout of dials and in the graphical development of gears, cams and linkages, it is often necessary to draw many radial lines from the same center. Considerable time can be saved in aligning the triangle or drafting-machine scale if a map tack is stuck into the board at the particular center. The map tack provides a physical stop to hold one end of the straightedge against while it is adjusted to the proper angle. The diameter of a map tack is just right to hold the straightedge far enough off center to bring the pencil point in line with the center while it is guided along the straightedge. — RICHARD H. HEIMANN, *Flushing, N. Y.*



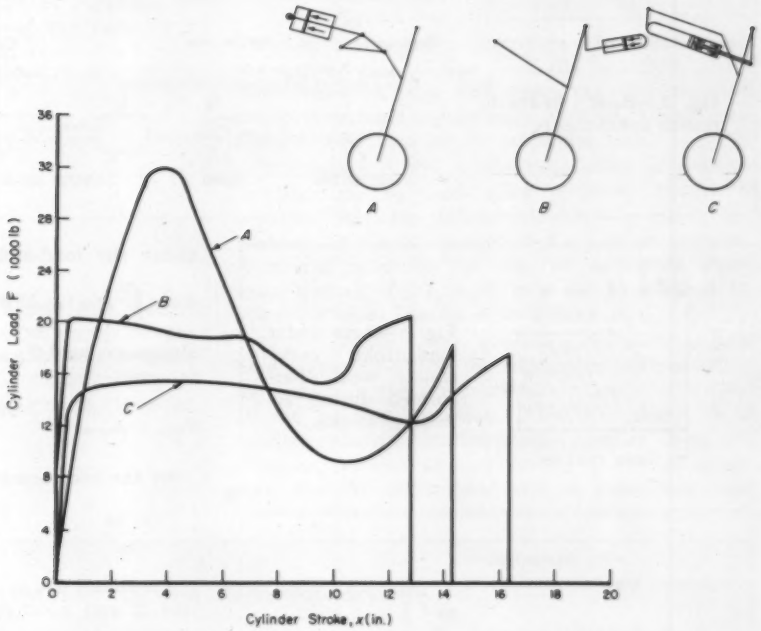


Fig. 1 — Load-stroke diagrams for three main-gear retraction-cylinder linkage arrangements.

By B. Saelman
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Lockheed Aircraft Corp.
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Hydraulic Actuating Systems

how to design for minimum weight and high efficiency

DESIGN requirements for a hydraulic actuating system are simply summarized: (1) the cylinder must exert a force high enough to overcome the peak external load, and (2) time required for the actuating stroke must fall within the desired limit.

Work performed by a cylinder in a given application—represented by the area under the load-stroke curve—is generally independent of the actuating-linkage design. In illustration of this point, three alternative arrangements for an aircraft landing-gear retraction system are shown in Fig. 1. Work required to lift the gear against gravity, air-drag and friction loads is constant, and areas under the three load-stroke curves are identical. Efficiencies, however, defined as the ratio of area under the load-stroke curve to the product of maximum load by total stroke—differ substantially for the three systems.

In this article, elements of a basic hydraulic system are considered to be a reservoir, pump, control valve, actuating cylinder and interconnecting plumbing, Fig. 2. Considering the mechanical work to be a fixed quantity, it will be shown that the cylinder yielding highest efficiency (defined in the preceding paragraph) is also of minimum weight, minimum oil volume and has minimum actuating time for a given fluid-flow rate.

Furthermore, since reservoir size, pump capacity, total fluid volume and line sizes are all proportional to cylinder size, these circuit elements are also smallest and lightest when cylinder size is minimum.

Efficiency vs. System Weight: Work performed during the cylinder actuating stroke equals area

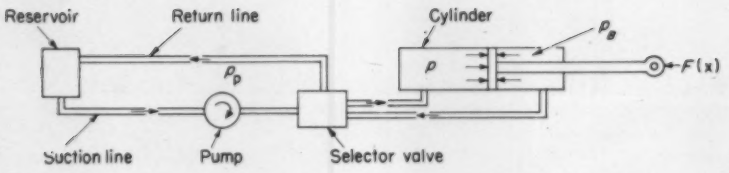


Fig. 2—Basic hydraulic system components.

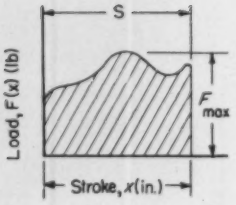


Fig. 3—Area under load-stroke curve equals work performed during actuating stroke.

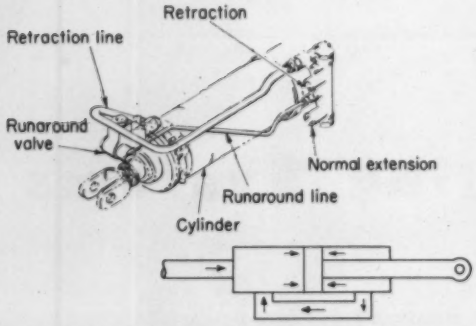


Fig. 4 — Runaround valve transfers fluid from one side of piston to the other, reducing fluid that must be supplied by the reservoir.

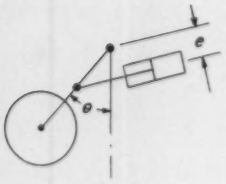


Fig. 5 — Effective moment arm as function of gear retraction angle.

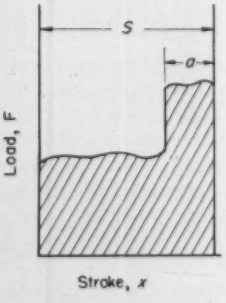


Fig. 6—If the load-stroke diagram peaks, as in region *a* here, use of boost-assist cylinder will improve system efficiency.

under the load-stroke diagram, Fig. 3, or

$$U = \int_o^S F(x)\,dx = F_{max}\,S\eta \qquad (1)$$

Maximum load F_{max} is related to fluid pressure as follows:

$$F_{max} = p_{o,max}\,A = \frac{\pi d^2\,p_{o,max}}{4} \qquad (2)$$

By the hoop tension stress formula,

$$t = \frac{p_p\,nd}{2\sigma} \qquad (3)$$

Assuming $p_{o,max} = p_p$, solving for $p_{o,max}$ in Equation 2 and substituting results in Equation 3,

$$t = \frac{2n\,F_{max}}{\pi\sigma d} \qquad (4)$$

Equations 3 and 4 apply both for the case where wall thickness is determined by ultimate material strength, and where radial deflection is the design criterion.*

Weight of the cylinder tube and fluid can be expressed as

$$W = W_c + W_f = \pi dtS\rho_c + \frac{\pi d^2 S\rho_f}{4} \qquad (5)$$

*B. Saelman—"Pressurized Cylinders and Spheres," MACHINE DESIGN, Vol. 29, No. 7, April 4, 1957, Page 121.

Nomenclature

A = Gross piston-head area, sq in.
A_r = Piston-rod area, sq in.
d = Cylinder inside diameter, in.
$F(x)$ = Load (as function of travel), lb
F_{max} = Maximum load, lb
n = Burst-pressure factor
p_B = Back pressure on cylinder, psi
p_o = Operating pressure, psi
p_p = Pump pressure, psi
Δp = Pressure drop, psi
Q = Rate of flow, cu in. per sec
S = Total stroke, in.
T = Time of movement, sec
t = Wall thickness, in.
U = Work, in-lb
V = Cylinder volume, cu in.
W = Weight, lb
W_c = Weight of cylinder, lb
W_f = Weight of fluid, lb
x = Displacement, in.
η = Efficiency
σ = Hoop tension stress, psi
ρ_c = Density of cylinder material, lb per cu in.
ρ_f = Density of fluid, lb per cu in.

Solving for s in Equation 1, d^2 in Equation 2, and substituting these values and the value of t from Equation 3 into Equation 5,

$$W = W_e + W_f = \frac{c_1 + c_2}{\eta} \qquad (6)$$

Constants c_1 and c_2 have the values

$$c_1 = \frac{2n\,U\rho_e}{\sigma}$$

$$c_2 = \frac{U\rho_f}{p_p}$$

Actuating Time: Equation 6 shows that weight of cylinder tube and fluid is inversely proportional to efficiency. End cap and piston-head weights are also near minimum. Since fluid volume is minimum when efficiency is maximum, time of actuation is

$$T = \frac{V}{Q} \qquad (7)$$

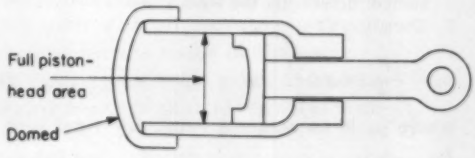
Time of movement is therefore also a minimum for a given rate of flow from the hydraulic pump. Since reservoir size and pump capacity required are proportional to cylinder volume, these components will also be of minimum size.

The curves in Fig. 1 show the effect of cylinder position on the load-stroke diagram. Design *B* provides the most efficient load-stroke curve and requires the least complicated tie-in mechanism. A weight reduction for the two actuators (both main gears) of 20 to 30 lb could be realized by changing from Design *A* to Design *B*.

When possible, the actuating cylinder should be designed to utilize the full piston-head area for movement in the direction of maximum load, say in the gear-up direction. This will result in a smaller cylinder, smaller pumps, smaller lines, etc. However, because of peculiarities of linkage geometry, the full piston-head area is sometimes used

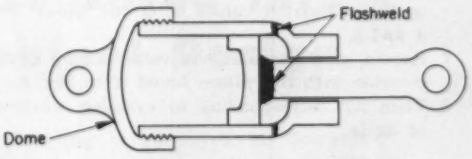
Cylinder Design Recommendations

1. Use the full piston-head area for the critical retraction or extension cycle when feasible.



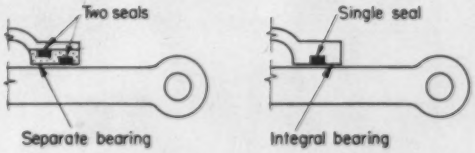
2. Use domed forgings for end caps of cylinders. Only one end cap need be removable.

3. Pressure or flash weld end cap to cylinder and piston head to piston rod when practicable. Removable internal end cap may prove lighter than external cap.



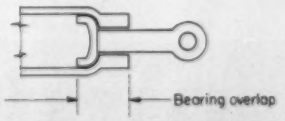
4. Use dural cylinder barrels and piston rods for lightly loaded cylinders. In many cases, hard-anodized aluminum barrels may be used instead of steel. If diametral deflection is critical in the cylinder barrel, aluminum will save little or no weight in comparison with steel.

5. Make the piston-rod bearing integral with the cylinder barrel; this eliminates one seal. If the bearing must be separate, consider use of hard-anodized aluminum instead of aluminum bronze. Undercut the bearing where possible.

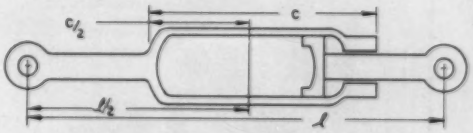


6. Locate fluid ports on the cylinder barrel rather than between end cap and terminal. This decreases overall length between terminals.

7. Use minimum bearing overlap if loading is primarily axial. An overlap of approximately 1.5 piston diameters is recommended.



8. Where length between terminals with the cylinder fully extended is fixed and column stability is critical, locate cylinder barrel equidistant from the terminals with the actuator in the fully extended position.



9. If substantial variation in operating pressure exists from the fully compressed to the fully extended position and diametral deflection is critical, consider tapering the wall in accordance with variation in pressure.

for the extension cycle.

For such a design, the run-around valve, Fig. 4, can be incorporated to minimize the weight of fluid in the reservoir. The run-around valve allows fluid to be moved from one side of the piston to the other, reducing both the amount of fluid required from the reservoir and reservoir size.

Moment Arm: If $e(\theta)$ is the effective moment arm of the cylinder with respect to the fulcrum, Fig. 5, and $M(\theta)$ is the applied torque of the external loads about the fulcrum, then

$$F(x)e(\theta) = M(\theta) \tag{8}$$

For maximum efficiency, $F(x)$ should be as nearly constant as possible, say, with the value c. Then,

$$e(\theta) = \frac{M(\theta)}{c} \tag{9}$$

and the effective moment arm should be proportional to the applied torque for maximum efficiency.

For cases where reasonably high efficiency cannot be obtained with a single cylinder, a "boost" cylinder in combination with the primary cylinder often proves effective. For example, if the external load-stroke curve is as shown in Fig. 6, a boost-assist cylinder designed to do useful work over the range a will help increase the overall efficiency.

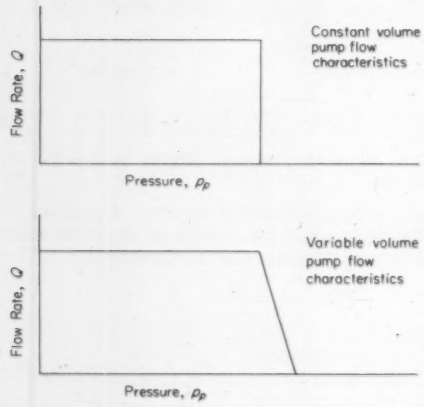


Fig. 7—Flow rate for constant and variable-volume pumps.

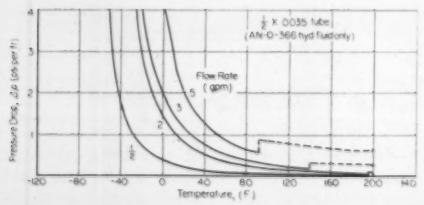


Fig. 8 — Typical relationships between pressure drop, rate of flow and line diameters.

Cylinder Diameter: After the cylinder is located so that work will be done most efficiently, the cylinder inside diameter is next determined. For minimum weight, cylinder diameter selection is usually a compromise choice with the diameters of connecting tubing.

For a constant-volume pump, Equation 7 determines time of movement. However, in a variable-volume system, because of the gradual reduction of flow in the region $p_1 \leqq p \leqq p_m$, determination of time of movement is more involved. From Fig. 2 the following relationships can be written:

$$F = p_o A - p_B A_B = p_o A - p_B(A - A_r) = (p_p - \Delta p - p_B)A + p_B A_r \tag{10}$$

Solving for A,

$$A = \frac{F - p_B A_r}{p_p - \Delta p - p_B} \approx \frac{F}{p_p - \Delta p - p_B} \tag{11}$$

Equation 11 expresses the gross piston area required as a function of external load, pump pressure and pressure losses.

The Optimum System: In order to optimize the system, the following procedure is used:

1. With the cylinder-bore and line diameters assumed, determine the load.
2. Then

$$p_o = \frac{F}{A} + p_B \tag{12}$$

where p_B is an assumed value, say 7 per cent of p_p.

3. Calculate

$$p_p = p_o + \Delta p \tag{13}$$

where Δp is assumed, say 8 per cent of p_p.

4. From Fig. 7*a* determine Q corresponding to p_p.
5. Calculate

$$Q_B = \frac{Q(A - A_r)}{A} \tag{14}$$

6. From Fig. 8, determine Δp and p_B corresponding to the calculated values of Q and Q_B of Steps 4 and 5.
7. Repeat until the assumed values of p_B and Δp coincide with the values found from Fig. 8.
8. Then ΔT corresponding to cylinder movement of Δx is

$$\Delta T = \frac{\Delta x A}{Q} \tag{15}$$

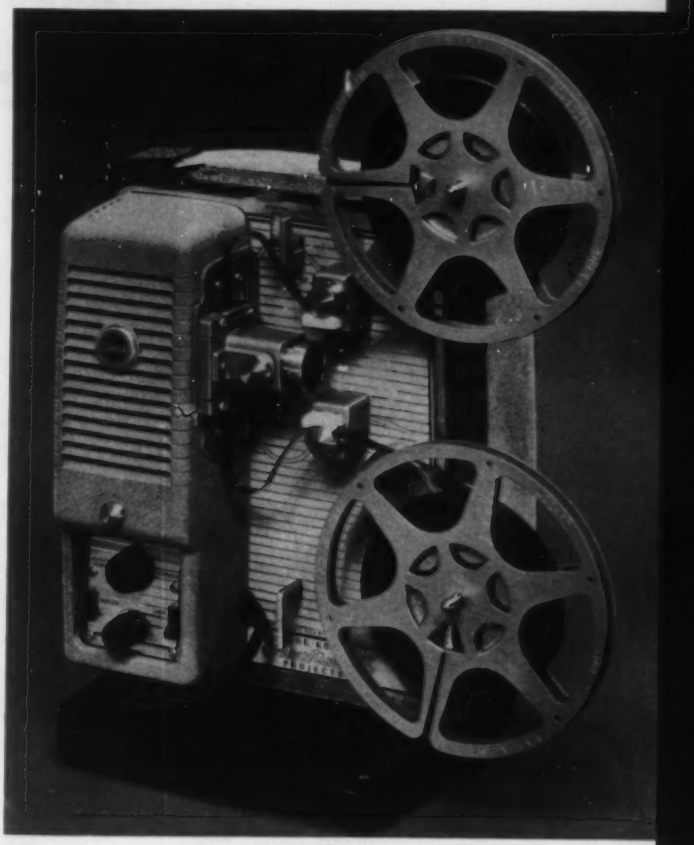
and

$$T_{tot} = A \sum_1^n \frac{\Delta x_i}{Q_i} \tag{16}$$

9. Corresponding weights of lines and the cylinder should be calculated for each series of computations, thereby determining the configuration for minimum total weight.

This step-by-step procedure can be repeated for each system that is under consideration. Selection of the optimum system will hinge on an evaluation of weight, efficiency, simplicity and cost.

Home Movie Projector Has Variable-Speed Control



Controlled - motion projection of home movies is offered in a new Eastman-Kodak 8-mm projector. Designed to show either slow or high-speed effects, the 500-w Kodak Showtime 8 (variable-speed model) can also be reversed or stopped for single-frame viewing. One adjustment knob controls drive-motor speed and another, direction of rotation. The variable-speed setting assures that movies can be shown at normal speed in spite of temporary fluctuations in line voltage.

Reel storage is provided by a receptacle in the projector base; there is room for two 400-foot reels. Projector is built into its own case, with all necessary operating instructions on the inside of the cover.

This design uses nylon gears and oil-impregnated bearings that never require oiling.

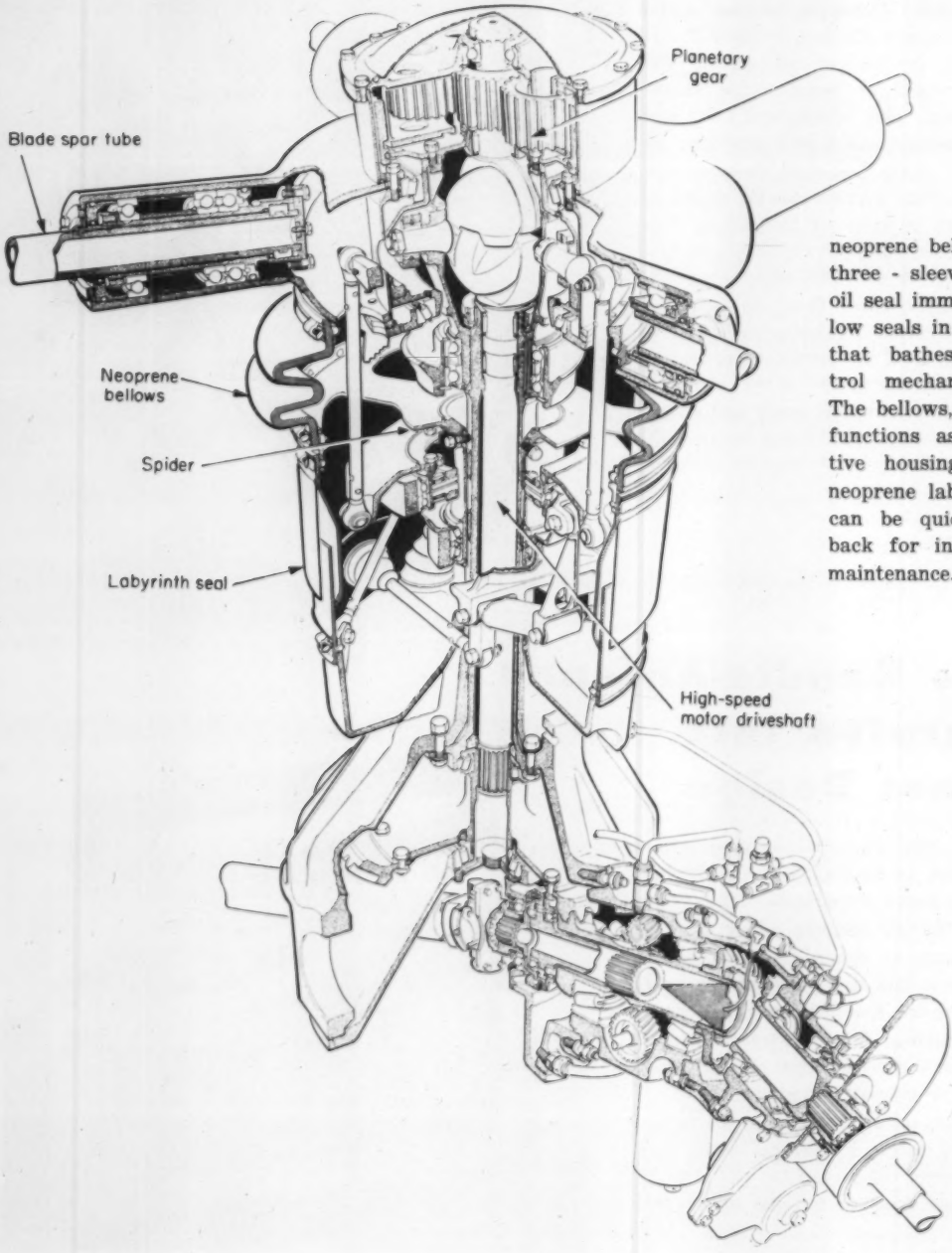
Radio Handle-Antenna Integrated into Cabinet Design

V-line styling is employed in Motorola's new Riviera series of portable radios. The Roto-Tenna handle antenna permits rotating the antenna to obtain maximum signal strength while the radio speaker is positioned to face the listener directly. Vernier tuning is provided for close-tolerance station selection. An earphone receiver jack is built in for private listening.

The all-steel cabinet is covered with rawhide-textured fabric in antique white and two-tone color combinations of antique white and lavender or antique white and navy blue.

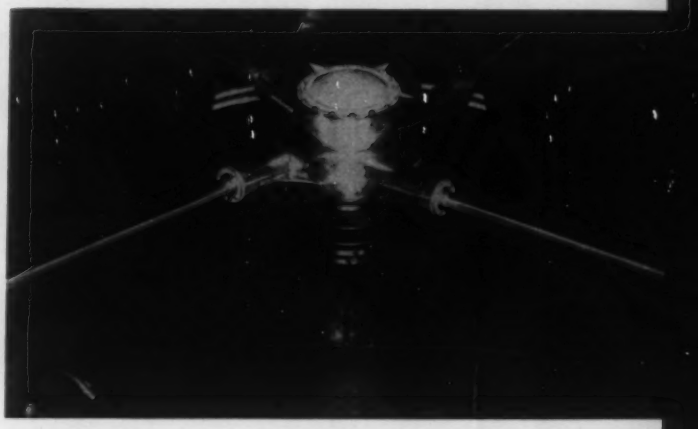
Neoprene Bellows Drives

Rotor pitch-control mechanism is driven by a ¼-in. thick molded neoprene bellows which serves as an annular "universal joint." The neoprene bellows and a three - sleeve labyrinth oil seal immediately below seals in the hot oil that bathes pitch-control mechanism parts. The bellows, which also functions as a protective housing, and the neoprene labyrinth seal can be quickly peeled back for inspection or maintenance.

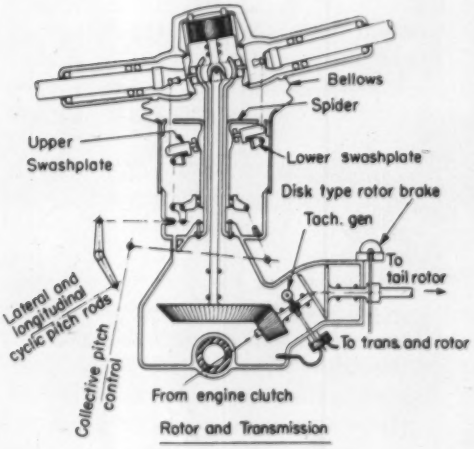


Rotor Pitch-Control Mechanism

In a simplified helicopter rotor-hub assembly developed by Doman Helicopters Inc., 1200 parts are eliminated as compared to previous designs. Although the rotor blades are driven by a high-speed driveshaft, a heavy neoprene bellows drives the pitch-control mechanism.

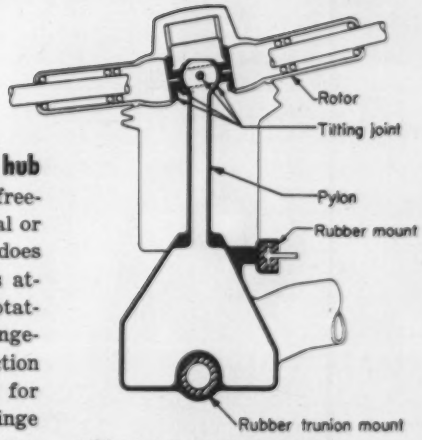


Rotational power to the bellows is supplied by the rotor hub, which is driven by a driveshaft through a unique planetary gear system. Lower end of bellows is attached to a spider and the labyrinth oil seal, both of which rotate. The spider rotates the upper swashplate. Rods connected to upper swashplate are connected to ends of pitch-control arms which, in turn, are coupled to the ends of the blade spar tubes. Through this system, pitch of the rotor blades are varied both cyclically, which determines helicopter speed and horizontal direction of travel, and collectively, which controls machine altitude.

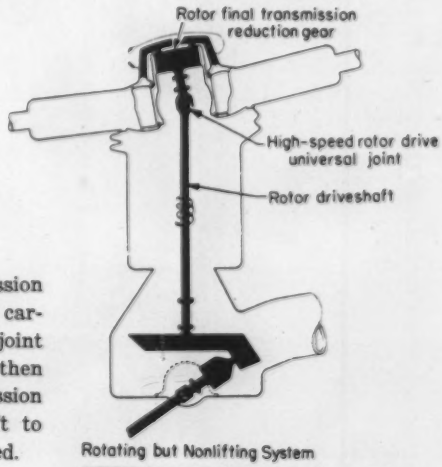


Rotor and Transmission

Hingeless rotor hub is mounted on a freely tilting universal or gimbal which does not rotate and is attached to a nonrotating pylon. The hingeless construction eliminates need for flap hinge, drag hinge and associated dampers.



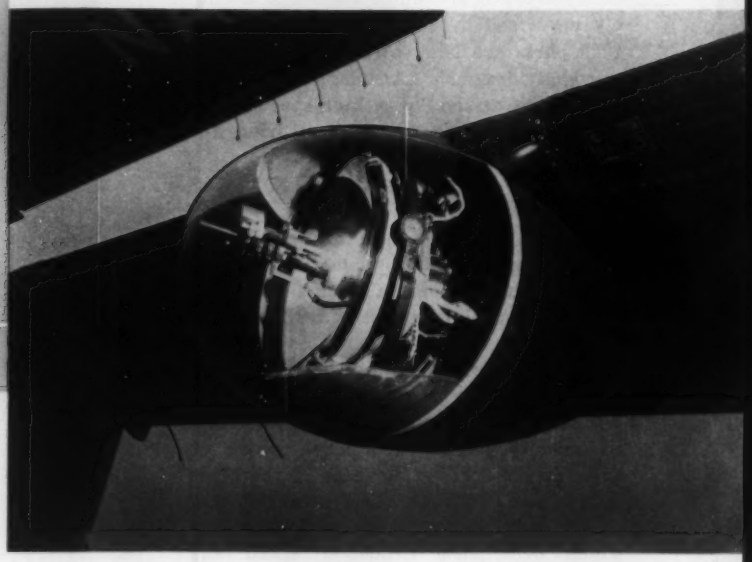
Lifting but Nonrotating System



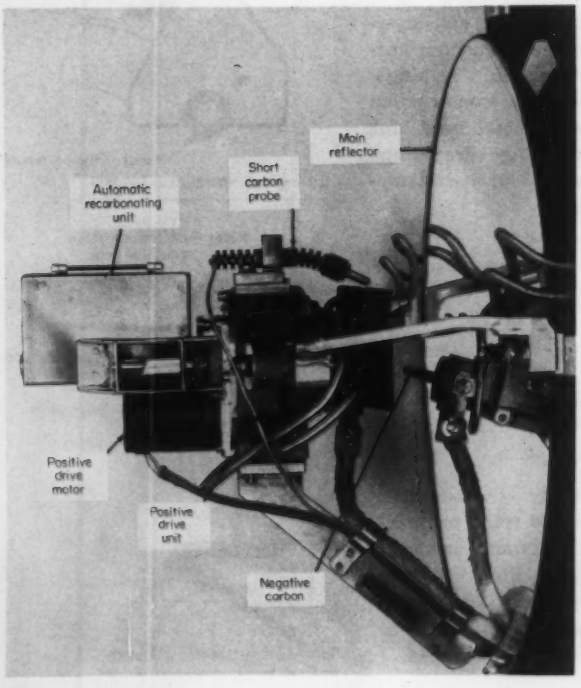
Rotating but Nonlifting System

Driveshaft from the primary transmission passes through the center of the rotor but carries none of the lifting load. A universal joint permits it to follow the tilting hub. It then passes into a planetary reduction transmission on top of the hub which allows the shaft to run at substantially higher than rotor speed.

Radar Controls



Designed primarily for antisubmarine work and sea-rescue operations, a powerful carbon-arc, airborne searchlight has been developed by the Arma Div. of American Bosch Arma Corp. Designated as the AN/AVQ-3, the 130-million candlepower light source can be used to sweep an area by manual or radar control or can be set to shine straight ahead.



A torpedo-shaped housing, made in three detachable sections, encloses the assembly. The forward or nose section is composed mainly of clear plastic through which the light beam is projected. The center section provides the supporting frame for the assembly and the means for hanging the lamp from a bombrack mounted underneath the airplane wing. The rear section contains the coolant reservoir plus a radiator which is exposed to the slip stream.

Automatic recarboning unit replenishes the fast-burning positive carbon at the rate of 35 in. per hour. Carbons 4 in. long are stored vertically in the magazine and are indexed and joined to the

Airborne Searchlight

carbon ahead such that they are drawn one after the other toward the arc. In operation, a clutch dog in the positive-carbon drive-motor gear train detects when the end of the carbon is approaching and engages a recarboning mechanism. The motor then winds up a spring and a spiral cam. As the sharp drop-off point of the cam is reached, the spring is released, driving the indexed carbon into engagement with the carbon ahead and declutching the mechanism.

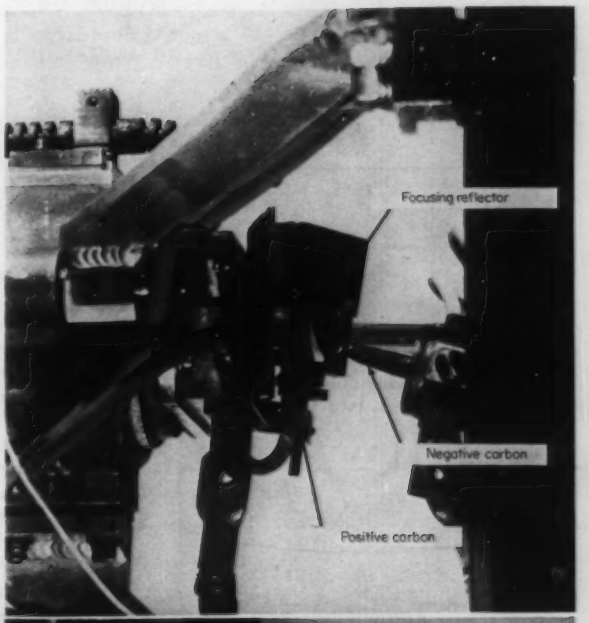
A planetary gear train is used to impart both axial and rotational motion simultaneously to the positive carbon. The axial motion makes up for the carbon vaporized by the arc and the rotational motion keeps the crater symmetrical.

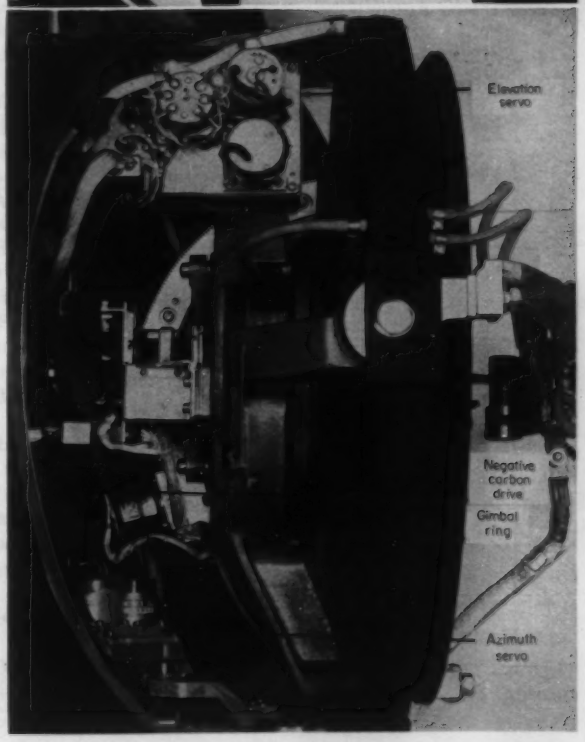
Image of positive-carbon crater is redirected through a large reflector center hole and onto a photosensitive focus-control diode by a small spherical reflector.

Material of the main reflector is aluminum, machined and polished to give a parabolic surface. Quartz is deposited on the reflecting surface as a protective film. Tripod supports for the positive-carbon drive unit prevent primary shadows between the arc and main reflector, improving light output.

Searchlight direction-control equipment is mounted behind the large main reflector. Electronic control circuits operate elevation and azimuth servomotors. Both servo units are identical unitized assemblies with plug disconnects. Each contains a 400-cycle servomotor, a synchro control transformer, a synchro generator and associated gearing.

The negative-carbon drive unit is also mounted in this assembly.





How to calculate stress-modifying shaft moments caused by

Bearing

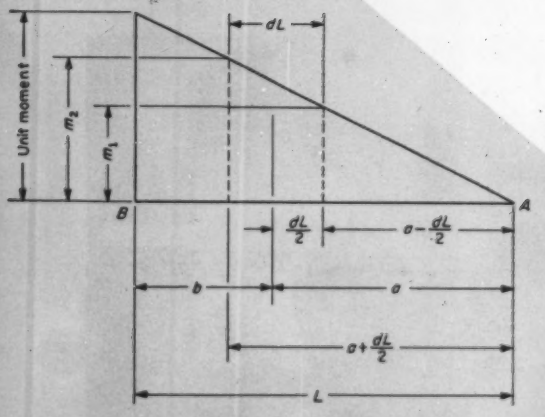


Fig. 1—Moment diagram for single-span shaft with two supports.

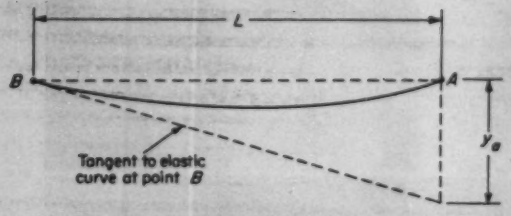


Fig. 2—Elastic-axis curve for single-span shaft.

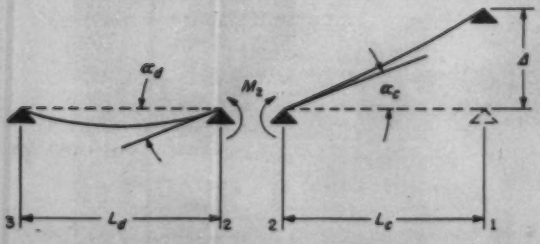


Fig. 3—Three-bearing shaft-support system. Bearing 1 is misaligned by distance Δ.

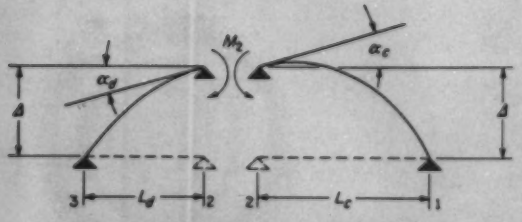


Fig. 4—Three-bearing shaft-support system. Bearing 2 is misaligned by distance Δ.

AXIS of rotation of any rotor assembly is determined by the bearings that support it. Assuming that rotor, bearings and supports are properly dimensioned and are aligned at assembly, each bearing will locate the shaft in a common rotational axis. However, if one or more bearing supports are translated with respect to the common rotational axis, shaft stresses and bearing reactions result. Neglecting such effects of bearing misalignment could result in unexpected shaft or bearing failure. It is the purpose of this article to develop and illustrate a method for evaluating bending moments and reactions on a non-uniform shaft when one or more bearings are misaligned.

Misalignment of initially aligned bearings often results from thermal expansion of one or more bearing supports. Resulting moments and reactions must be algebraically summed with dead-weight moments and reactions if true shaft stresses and bearing loads are to be determined. Resulting bearing reactions, depending upon which bearing is misaligned, either aid or oppose the dead-weight reactions. If misalignment relieves the dead-weight load, it is possible in the case of plane bearings to reduce bearing pressures to the point where an unstable oil film results in oil whip, which is a phenomenon of self-excited vibration.[1,2]

Certain additional bearing characteristics, such as clearance, length, and self-alignment capabilities, are not considered here. Neglecting self-alignment capabilities, however, is a conservative approach and is recommended when bearings are not specifically designed to be self-aligning. This article is concerned with theory and application of the influence-factor method for determining moments in deflected shafts.

The Influence Factor: It can be shown that for small beam slopes (an assumption valid in the majority of beams), the differential equation for the deflection y of a point on the elastic line of a beam at a distance x from the origin of the co-ordinate system can be expressed as[3]

$$EI\frac{d^2y}{dx^2} = M \qquad (1)$$

[1]References are tabulated at end of article.

Misalignment

By Augustine J. Scalzo
Analytical Engineer, Curtiss-Wright Corp. Turbomotor Div., Princeton, N. J.

From this fundamental relationship, the *moment-area theorems* can be obtained:[3]

Theorem 1: Difference in slopes $(\theta_b - \theta_a)$ between points A and B in a straight beam subjected to bending is equal to the area of the M/EI diagram between these points.

Theorem 2: For a straight beam subjected to bending, the distance measured vertically from any point A on the elastic curve to a tangent drawn at a second point B of the elastic curve is equal to the moment of the M/EI diagram between points A and B with respect to point A.

Theorem 2 will be used to develop the influence-factor equations. Moment diagram of a span between two supports is shown in Fig. 1. A unit moment is assumed to act at support B. Slopes of the elastic curve at A and B due to application of the unit moment at B are referred to as *influence factors*.

The unit moment at B will naturally cause the slopes at A and B to differ. Therefore, expressions are needed for the slopes at the support where the unit moment is applied and at the opposite support.

The expression for θ_b can be obtained from Fig. 2. Since all slopes are assumed to be small, tangent of the slope at B can be taken equal to the angle in radians. Therefore, deviation of point A with respect to point B divided by the beam length will equal the slope in radians. This relation can be expressed as

$$\frac{y_a}{L} = \theta_b \qquad (2)$$

From Theorem 2, Equation 2 can be rewritten as

$$\frac{M_{AB}}{LEI} = \theta_b \qquad (3)$$

where M_{AB} is the moment of the M diagram from A to B with respect to A. The numerator of Equation 3 can be evaluated by reference to Fig. 1. By similar triangles:

$$\frac{1}{L} = \frac{m_1}{\left(a - \frac{dL}{2}\right)}$$

$$\frac{1}{L} = \frac{m_2}{\left(a + \frac{dL}{2}\right)}$$

$$m_1 = \frac{2a - dL}{2L}$$

$$m_2 = \frac{2a + dL}{2L}$$

Therefore, Equation 3 can be written as

$$\sum \left\{ dL \left(\frac{2a - dL}{2L} \right) a + \frac{dL}{2} \left[\left(\frac{2a + dL}{2L} \right) - \left(\frac{2a - dL}{2L} \right) \right] \left(a + \frac{dL}{2} - \frac{dL}{3} \right) \right\} = LEI\,\theta_b \qquad (4)$$

which simplifies to

$$\sum \frac{1}{12\,L^2\,E} \left(\frac{12\,a^2 dL + dL^3}{I} \right) = \theta_b \qquad (5)$$

Similarly, the expression for θ_a, the slope of the elastic curve at support A, is evaluated as

$$\sum \frac{1}{12\,L^2\,E} \left(\frac{12\,abdL - dL^3}{I} \right) = \theta_a \qquad (6)$$

Equations 5 and 6 are influence factors in their

Nomenclature

a	= Distance from center of dL to opposite support
b	= Distance from bearing where unit moment is applied to center of dL
dL	= Length of arbitrary beam section
L	= Beam length
L_c L_d	= Span lengths
M_2	= Bending moment at support 2
m_1, m_2	= Moments at extremes of arbitrary section
α_c	= Slope at bearing 2 on span 1-2
α_d	= Slope at bearing 2 on span 2-3
Δ	= Bearing misalignment
θ_a	= Slope of elastic line at support opposite support where unit moment acts
θ_b	= Slope of elastic line at support where unit moment acts
θ_c	= Slope at bearing 2 due to unit moment at bearing 2 on span 1-2
θ_d	= Slope at bearing 2 due to unit moment at bearing 2 on span 2-3

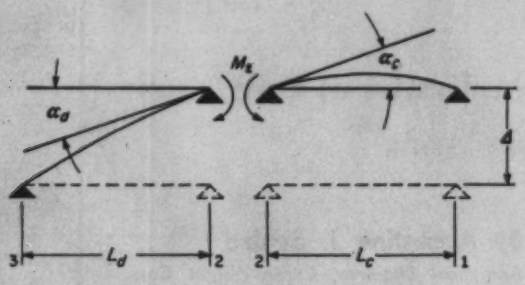


Fig. 5—Three-bearing shaft-support system. Both bearings 1 and 2 are misaligned.

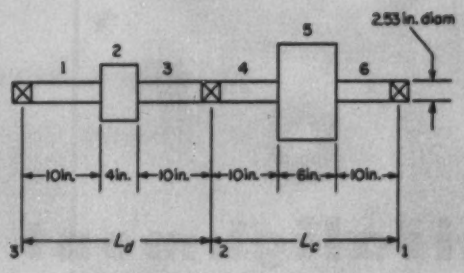


Fig. 6—Two-span nonuniform shaft and bearing-support system.

Example—Two-Span Shaft System

Problem is to determine bending moment and resulting shaft stress at the center support of a two-span shaft system, Fig. 6. Vertical thermal expansion of support 1 is assumed to be ¼-in. Table 1 illustrates a tabulation procedure that facilitates calculation of influence factors.

Table 1—Parameters for Sections 1—6

Section	a	a^2	dL	dL^3	I	$1/I(12a^2dL + dL^3)$
1	5	25	10	1000	2	2,000
2	12	144	4	64	12	581
3	19	361	10	1000	2	22,160
4	21	441	10	1000	2	26,960
5	13	169	6	216	20	619
6	5	25	10	1000	2	2,000

From values tabulated in Table 1 for sections 1, 2, 3:

$$\sum \frac{1}{I}(12a^2\,dL + dL^3) = 24{,}741 \qquad \text{(E-1)}$$

Equation 5 then gives

$$\theta_d = \sum \frac{1}{12\,L_d^2\,E}\left(\frac{12a^2dL + dL^3}{I}\right)$$

$$= \frac{24{,}741}{12(24^2)(30)(10^6)}$$

$$= 1.193 \times 10^{-7} \qquad \text{(E-2)}$$

By a similar method, θ_c can be calculated. From the results of Table 1:

$$\sum \frac{1}{I}(12a^2dL + dL^3) = 29{,}579 \qquad \text{(E-3)}$$

Equation 5 then gives

$$\theta_c = \sum_d \frac{1}{12\,L_c^2\,E}\left(\frac{12a^2dL + dL^3}{I}\right)$$

$$= \frac{29{,}579}{12(26^2)(30)(10^6)}$$

$$= 1.2154 \times 10^{-7} \qquad \text{(E-4)}$$

Value of moment M_2 is calculated as

$$M_2 = \frac{\Delta}{L_c}\left(\frac{1}{\theta_c + \theta_d}\right)$$

$$= \frac{0.25}{26.0}\left[\frac{1}{(1.2154 + 1.1931)(10^{-7})}\right]$$

$$= 39{,}923 \text{ lb-in.} \qquad \text{(E-5)}$$

Bending moment due to dead weight is neglected in this example. Shaft stresses are calculated as

$$\sigma = \frac{Mc}{I}$$

$$= \frac{(39{,}923)(2.53)}{4}$$

$$= 25{,}251 \text{ psi} \qquad \text{(E-6)}$$

Shaft stresses can be further investigated by assuming bending stress to be a variable stress in combination with existing torsional shear stress. Stress-concentration factors can be included if applicable. Such a complete analysis is outlined in Reference 4.

Reactions are determined from Equations 10, 11 and 12 as

$$R_1 = \frac{M_2}{L_c} = \frac{39{,}923}{26} = 1536 \text{ lb}$$

$$R_3 = \frac{M_2}{L_d} = \frac{39{,}923}{24} = 1663 \text{ lb}$$

$$R_s = \frac{-R_1(L_c + L_d)}{L_d} = \frac{-1536(26 + 24)}{24} = -3199 \text{ lb} \qquad \text{(E-7)}$$

most convenient form. They can be used to great advantage on a nonuniform shaft system.

Moment and Reaction Equations: Influence-factor equations are based on a unit moment; the slope due to the actual moment is therefore the product of the actual moment and the influence factor. This fact will be used to develop moment and reaction equations. In the development, bending moments are considered positive if they place the upper fibers of the beam in compression.

A three-bearing system will be used to illustrate application of the influence-factor equations. For clarity, elastic curves shown in Figs. 3, 4, and 5 are curves that would result if no bearing restraint were present.

Fig. 3 illustrates a three bearing system with bearing 1 misaligned by an amount Δ. Absolute magnitude of M_2 can be determined from the condition of continuity of the deflection curve at the support. Slopes are considered positive if angles of rotation are clockwise. From Fig. 3,

$$\alpha_d = \alpha_e \tag{7.1}$$

$$-M_2\,\theta_d = \frac{-\Delta}{L_e} + M_2\,\theta_e \tag{7.2}$$

$$M_2 = \frac{\Delta}{L_e}\left(\frac{1}{\theta_e + \theta_d}\right) \tag{7.3}$$

Similarly, with bearing 2 misaligned by an amount Δ as shown in Fig. 4,

$$\alpha_d = \alpha_e \tag{8.1}$$

$$-\frac{\Delta}{L_d} + M_2\,\theta_d = \frac{\Delta}{L_e} - M_2\,\theta_e \tag{8.2}$$

$$M_2 = \frac{\left(\frac{\Delta}{L_d} + \frac{\Delta}{L_e}\right)}{(\theta_e + \theta_d)} \tag{8.3}$$

In this case, since M_2 places upper fibers in tension, M_2 is negative.

By the same analysis, if both bearings 1 and 2 are misaligned (Fig. 5),

$$\alpha_d = \alpha_e \tag{9.1}$$

$$-\frac{\Delta}{L_d} + M_2\,\theta_d = -M_2\,\theta_e \tag{9.2}$$

$$M_2 = \frac{\Delta}{L_d}\left(\frac{1}{\theta_e + \theta_d}\right) \tag{9.3}$$

Since this moment also places upper fibers in tension, the moment is again negative.

Bearing reactions may be determined by summation of forces and moments. Assuming upward reactions positive,

$$R_1 = \frac{M_2}{L_e} \tag{10}$$

$$R_3 = \frac{M_2}{L_d} \tag{11}$$

$$R_2 = \frac{-R_1(L_e + L_d)}{L_d} = \frac{-R_3(L_e + L_d)}{L_e} \tag{12}$$

$$R_1 + R_2 + R_3 = 0 \tag{13}$$

The influence-factor method presented herein is accurate and is particularly suitable for nonuniform shaft systems. Formulas developed and the hypothetical example illustrate use of the method for two-span (three-bearing) shaft systems. Development of the two-span moment equations utilizes only the influence factor defined by Equation 5, which is the slope at a bearing produced by a unit moment at the same bearing. If more than two spans are investigated, however, the influence factor defined by Equation 6 (slope at the bearing opposite to the bearing where the unit moment is applied) must also be included in the analysis. For example, in a three-span system the center span has moments at both extremities. Slope at either extremity is therefore a function of the moment at the opposite support, as well as of the moment at the support in question. The same principle of deflection-curve continuity at the support applies, and moment equations can be developed in a manner similar to that for the two-span moment equations.

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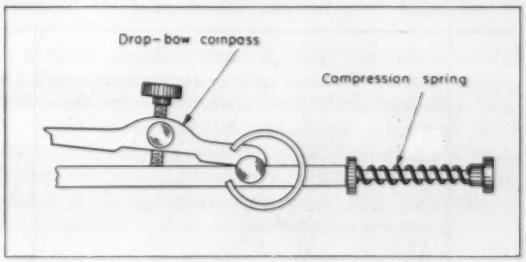
Tips and Techniques

Improving Compass

When using a drop-bow compass it usually must be spun several times to produce a heavy line. To do so, it is necessary to exert a uniform pressure on the pencil point while spinning it. This can be speeded and more uniform results ob-



tained by installing a small compression spring on the shaft between the head and knurled nut. This in effect spring loads the compass lead. All that is necessary to produce a heavy line is one revolution of the compass arm. It may be necessary to experiment with the kind of spring needed as determined by the style of the compass and the heaviness of the line required.—GENE KRYSKO, *Dole Valve Co., Chicago.*

By Frank A. Votta, Jr.
Chief Engineer
Hunter Spring Co.
Lansdale, Pa.

Design and application characteristics of

NONLINEAR SPRINGS

CONVENTIONAL basis for spring design and analysis is a linear relationship between load and deflection. However, where application requirements impose unconventional load conditions, several spring forms have been developed to provide varying spring gradient over the operating range. Types and design characteristics of these nonlinear springs are discussed in this article.

Conical and Barrel Springs: Unless specially formed, conical and barrel compression springs* are inherently nonlinear because of progressive closing out of the coils throughout deflection. Generally, the geometry of the mechanism dictates their use, rather than their nonlinear load-deflection characteristics. However, these springs, which become stiffer as they are compressed, do have occasional mechanical utility.

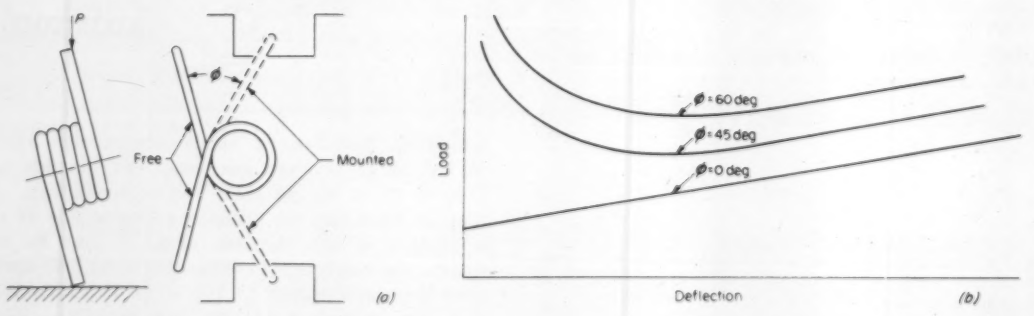
Torsion Springs: One of the most useful nonlinear forms is the torsion spring with an unsupported coil, Fig. 1. It is easy to design, easy to make and easy to use. It is particularly useful where nearly flat load curves are required with stiffness adjustable at small deflections. Often torsion springs with an unsupported coil are indicated as substitutes for compression springs where space is insufficient for mounting conventional compression springs. However, the use of these springs is limited because the arms become unduly offset

*Frank A. Votta Jr.—"Special Spring Forms," MACHINE DESIGN, Vol. 29, No. 5, March 7, 1957, Page 106.

Nomenclature

b = Width of flat column spring, in.
E = Modulus of elasticity, psi
F = Maximum allowable deflection of spring, in.
f = Natural frequency of spring system, cps
g = Acceleration due to gravity, 32.2 ft per sec per sec
K = Spring gradient, lb per in.
L_0 = Active length of flat column spring, in.
L_1, L_2 = Height of flat column spring corresponding to load condition identified by subscript, in.
P_1 = Applied load to cause initial buckling of flat column spring, lb
P_2 = Applied load at which ends of flat column spring become parallel, lb
S_{max} = Maximum stress developed under load in flat column spring when ends are parallel, psi
t = Thickness of flat column spring, in.
W = Weight, lb
ϕ = Angular deflection of torsion spring arm from free position, deg

Fig. 1—Torsion spring with unsupported coil showing, *a*, typical mounting arrangement and, *b*, load deflection relationships for three different mounting conditions.



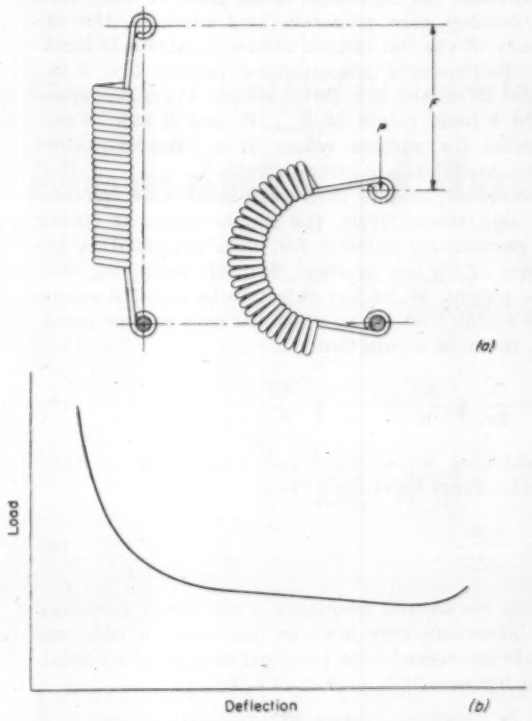


Fig. 2 — Flex'ator spring for compression load applications. General mounting arrangement is shown at *a;* characteristic load-deflection relationship at *b.*

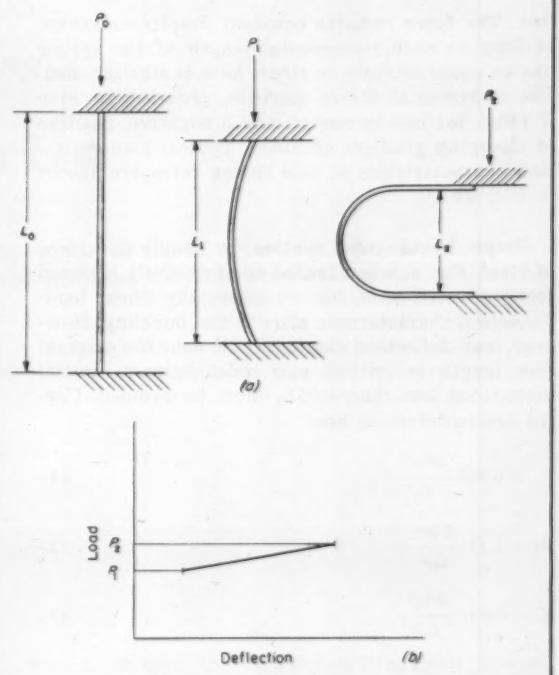


Fig. 4—Flat column spring for compression loading showing, *a,* general operating characteristics and, *b,* typical load-deflection curve.

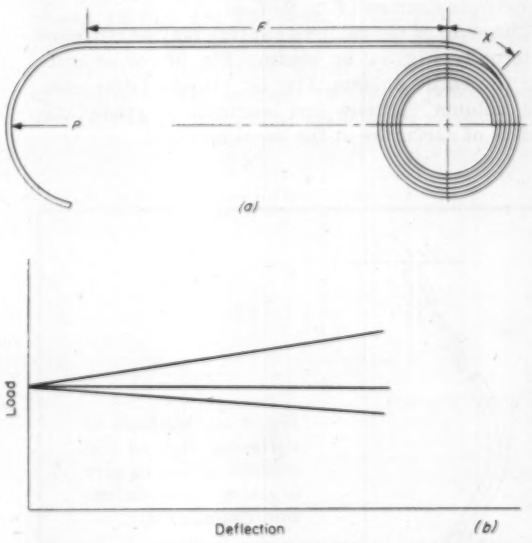


Fig. 3 — Neg'ator spring for extension load applications. Typical spring design is shown at *a;* characteristic load-deflection relationships at *b.*

if more than two turns are used in the spring body, Fig. 1*a*.

The greater the initial deflection from the free angle, ϕ, required to mount the spring in the mechanism, the greater the load must be before the mechanism will begin to operate, Fig. 1*b*. Thereafter, the gradual lengthening of the moment arms tend to compensate for normal load build-up.

Helical Compression Spring: Another useful spring form is the close-wound helical spring (Flex'ator spring) with high initial tension, Fig. 2. When mounted with off-center arms and used as a compression spring, it is capable of a wide range of force-deflection characteristics. Its load curve is characterized by a peak, Fig. 2*b*, followed by a service region of nearly zero gradient.

Coiled Flat Spring: The spring (Neg'ator spring) in Fig. 3 is formed from a strip of flat spring material. It is capable of approximating negative or zero gradients. Prestressed during manufacture, the relaxed spring strip forms a tight coil. When the free end of the coil is withdrawn, it exerts a constant force in attempting to return to its relaxed position. In Fig. 3*a*, the force at any extension is determined only by the work required to straighten the material from its coiled condi-

tion. The force remains constant despite extension as long as each incremental length of the spring has an equal increase in stress as it is straightened. The incremental stress increase, occuring in zone X (Fig. 3*a*) can be varied, and a negative, positive or changing gradient obtained. Typical load-deflection characteristics of this spring form are shown in Fig. 3*b*.

Simple Rectangular Section: A simple flat piece of steel, Fig. 4, when loaded compressively between freely pivoted ends, has an essentially linear load-deflection characteristic after initial buckling. However, load-deflection characteristic near the original free length is critical and indeterminant. Initial deflections less than $0.05L_0$ must be avoided. Useful design formulas are:

$$P_1 = 0.823\frac{Ebt^3}{L_0^2} \quad (1)$$

$$P_2 = 1.15\frac{Ebt^3}{L_0^2} \quad (2)$$

$$K = 0.600\frac{Ebt^3}{L_0^3} \quad (3)$$

$$S_{max} = 2.63\frac{Et}{L_0} \quad (4)$$

Table 1—Calculated Data for Flat Column Springs*

t (in.)	S_{max} (psi)	P_2 (lb)	K (lb per in.)
0.0127	100,000	0.716‡	0.0365
0.019	150,000	2.36	0.123
0.0254	200,000	5.6	0.292
0.0317	250,000	10.9	0.568

*Based on Equations 1 to 4 with $b = 1$ in., $L_0 = 10$ in. and $E = 30{,}000{,}000$ psi.
‡Less than 12 oz.

Because the maximum stress must be very high to develop even moderate load capacity, the capacity of the flat column spring is extremely limited. To illustrate this condition, assume $b = 1$ in., $L_0 = 10$ in. and $E = 30 \times 10^6$ psi. From Equations 1 to 4 then, values of S_{max}, P_2 and K can be calculated for various values of t. Representative calculated data are given in Table 1.

However, despite their very small load capacity at high stress levels, the simple columnar spring is particularly suitable for vibration isolation because of its low gradient, Fig. 4*b*. Assuming that the weight, W, of the object to be isolated equals the spring load, P_2, at which the ends become parallel, it can be shown that

$$f = \frac{1}{2\pi}\sqrt{\frac{Kg}{W}} = \frac{1}{2\pi}\sqrt{\frac{Kg}{P_2}} \quad (5)$$

Combining Equations 2 and 3 gives: $K = 0.522\ P_2/L_0$. From Equation 5 then,

$$f = \frac{2.26}{\sqrt{L_0}} \quad (6)$$

Thus, the natural frequency of the spring mounting is inherently very low—on the order of only one cycle per second—for practical lengths of material. For instance, if $L_0 = 3$ in., $f = 1.3$ cps.

Stiffened Rectangular Sections: The load characteristic of a columnar spring can be made strongly negative by stiffening the legs at both ends, Fig. 5. The principal factor in producing this negative characteristic is the gradual increase of the moment arm as deflection continues. These springs are characterized by the ability to deflect to extreme degrees ($F = 0.8L_0$).

The arms of the columnar spring may be stiffened externally, Fig. 5*a*; by beading, Fig. 5*b*; or by arching the entire column, Fig. 5*c*. In the latter case, the column flattens and assumes a predictable radius of curvature at the buckling point.

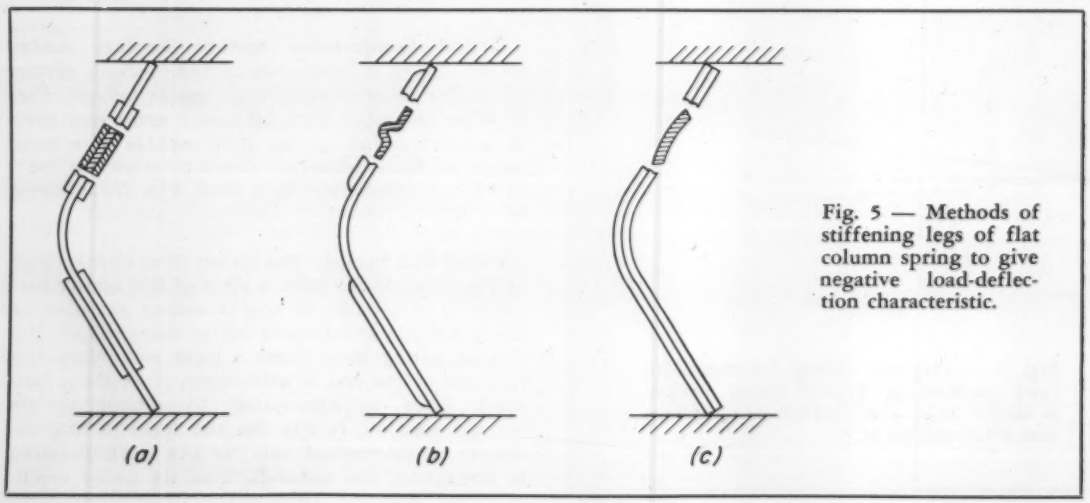


Fig. 5 — Methods of stiffening legs of flat column spring to give negative load-deflection characteristic.

Graphical method of calculating

Moments of Inertia

. . . of components with irregular or nonsymmetrical outlines

By Ricardo Chicurel
Princeton University
Princeton, N. J.

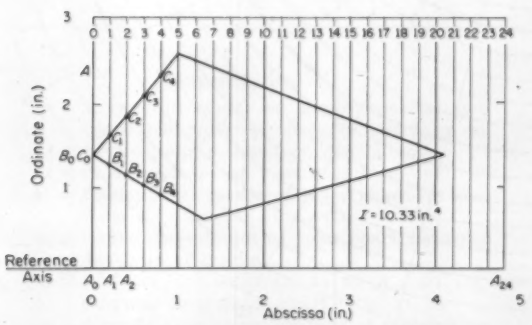
UNSYMMETRICAL or irregular structural cross-sections are frequently encountered in engineering design and analysis. Determining moments of inertia of such configurations is difficult since formulas that are simple to use do not exist.

A technique is presented here whereby a plane irregular configuration, such as shown in Fig. 1*a*, is redrawn on polar graph paper into the form shown in Fig. 1*b*. The area of the redrawn configuration is planimetered, and this value is substituted into a formula which gives the moment of inertia of the original figure. A polar graph with a nonuniform radial scale, such as shown in Fig. 2, is used to redraw the irregularly shaped figures. Since in this technique it is not necessary to draw on the polar chart directly, it may be used any number of times.

Solution Procedure: This method will be demonstrated with the quadrilateral shape in Fig. 1*a* because its moment of inertia can be readily computed analytically to provide a check on the method. The solution procedure is as follows:

(1) Draw the axis line to which the moment of inertia is to be determined in correct relation to the geometrical shape.

(2) Draw line A-A_0 perpendicular to the axis



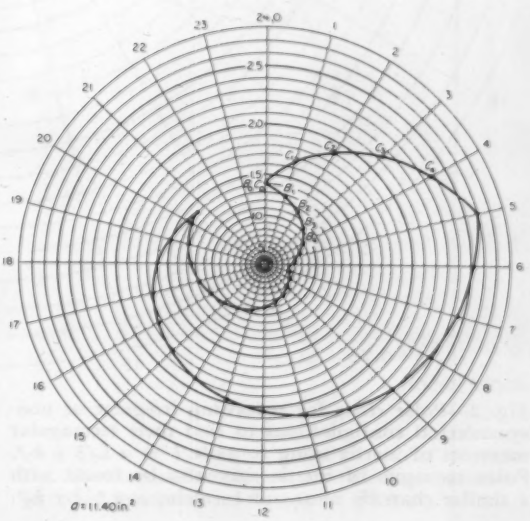


Fig. 1 — Typical nonsymmetrical configuration drawn on rectangular co-ordinate chart, *a*; chart is arbitrarily divided into 24 strips. By the method presented in this data sheet, the shape in *a* is redrawn on a special polar chart to produce the form in *b*. The planimetered area of the configuration in *b* multiplied by a constant gives the moment of inertia of the outline shown in *a*.

and tangent to the configuration at its left extreme.

(3) Starting from A_0, and continuing to the right along the axis, mark off points A_1, A_2, . . . A_{24} dividing the axis in 24 equal segments. The length A_0A_{24} should be sufficient to permit projecting any point of the figure onto the axis within the segment A_0 A_{24}; the exact length of A_0 A_{24} however, is arbitrary.

(4) At each point A_1, A_2, . . . A_{24} drop a perpendicular to the axis and intersecting the outline of the figure at B_1, C_1; B_2, C_2; etc.

(5) Place a sheet of tracing paper over the polar graph in Fig. 2 and plot each of the points B_0, C_0; B_1, C_1; etc., on the tracing paper as shown in Fig. 1*b*. The co-ordinates of each point on the tracing laid over the polar graph, Fig. 2, are: (1) The number designating the radial line in

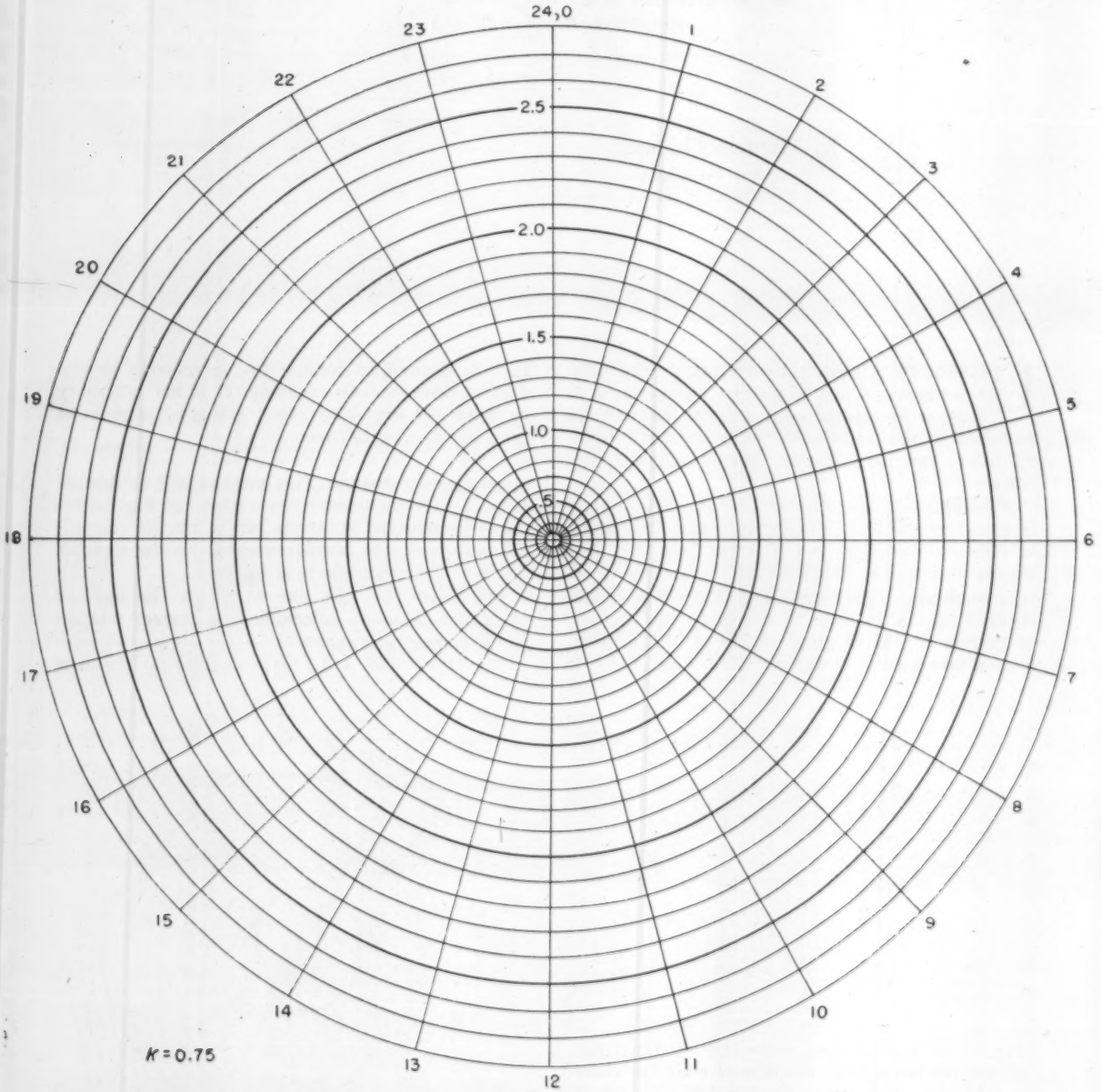


Fig. 2—Polar chart for redrawing irregular or nonsymmetrical configurations to find their rectangular moments of inertia using formula $I = a\ L/3\ \pi\ k_1^2$. Polar moments of inertia may also be found with a similar chart by means of formula $= 0.5\ a\ /\ k_2^2$.

the polar graph that corresponds to the perpendicular to the reference axis in Fig. 1 with the same number and (2) the number that designates the circle on the polar graph in Fig. 2 corresponding to the perpendicular distance down to the reference axis in inches ($A_0 B_0$, $A_0 C_0$, $A_1 B_1$, $A_1 C_1$, etc.). These distances are either measured with a scale or, more conveniently, read off the graph paper if graph paper is used. For example, point B_4 lies on radial line 4 of the polar graph. Since the distance between point B_4 and the reference axis in Fig. 1*a* is 0.9-in., it accordingly lies on the circle corresponding to 0.9-in. in the polar graph. All points are located in a similar manner.

(6) Draw a smooth curve through the points plotted as done in Fig. 1*b*.

(7) Determine the area of the resulting enclosed configuration by means of a planimeter.

(8) If a denotes the area in square inches obtained in the preceding step, the moment of inertia required in inches to the fourth power is obtained by the formula

$$I = \frac{aL}{3\pi k_1^2}$$

where L is the distance from A_0 to A_{24} expressed in inches and k_1 is the radial scale factor of the polar graph; for the graph in Fig. 2, $k_1 = 0.75$. The radial distance in the graph is related to the radial co-ordinate ρ by the formula

$$s = k_1 \rho^{3/2}$$

where s is expressed in inches.

Polar Moment of Inertia: Determining the polar moment of inertia of a plane figure about a point is accomplished in a manner similar to the technique used to find the moment of inertia about a horizontal reference axis with the following variations:

(1) Draw 24 radial lines from the pole point P.

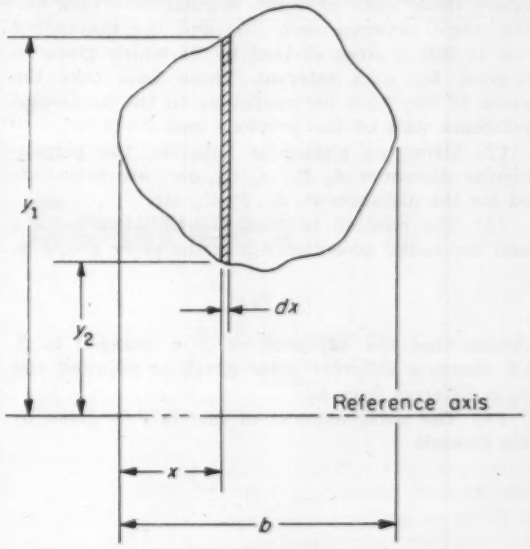


Fig. 3—Generalized irregular configuration with dimensions.

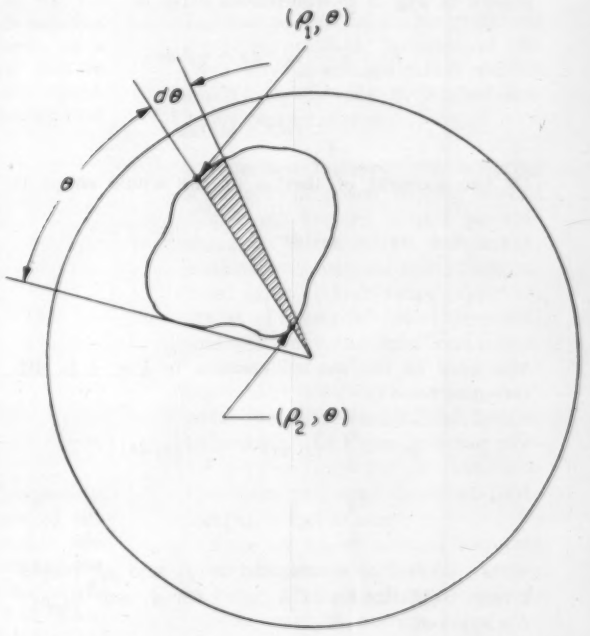


Fig. 4—Irregular configuration of Fig. 3 transferred in general form to a polar chart.

Nomenclature

a = Area of irregular or nonsymmetrical configuration redrawn on polar chart, sq in.
I = Rectangular moment of inertia, in.^{4}
J = Polar moment of inertia, in.^{4}
k_1 = Radial scale factor of polar chart for rectangular moments of inertia
k_2 = Radial scale factor of polar chart for polar moments of inertia
L = Distance from points A_0 to A_{24} on rectangular co-ordinate chart (Fig. 1), in.
x = Any distance along abscissa of rectangular co-ordinate chart, in.
y = Any distance along ordinate of rectangular co-ordinate chart, in.
θ = Any angular co-ordinate on polar chart, deg
ρ = Any radial co-ordinate on polar chart, in.

Space these lines at equal angular intervals, i.e., the angle between each line and the succeeding one is 360 degrees divided by 24 which gives 15 degrees for each interval. These lines take the place of the lines perpendicular to the horizontal reference axis of the previous case.

(2) Using an analogous notation, the perpendicular distances $A_0 B_0$, $A_0 C_0$, etc., are substituted for the distances $P_0 B_0$, $P_0 C_0$, etc.

(3) The relation between the radial distance s and the radial co-ordinate ρ in the polar graph is,

$$s = k_2 \rho^2$$

Notice that the exponent of ρ is changed to 2. Of course a different polar graph is required and k_2 is different from k_1.

(4) The polar moment of inertia J is given by the formula

$$J = \frac{a}{2k_2^2}$$

For either of these methods the number of divisions is arbitrary and one may use any number which may be convenient for a particular problem.

Basis of Method: The moment of inertia of a narrow element in the irregular configuration shown in Fig. 3 in differential form is

$$dI = \frac{1}{3}(y_1^3\,dx - y_2^3\,dx)$$

$$= \frac{1}{3}(y_1^3 - y_2^3)\,dx$$

Or the moment of inertia of the whole shape is

$$I = \frac{1}{3}\int_0^b (y_1^3 - y_2^3)\,dx$$

$$= \frac{1}{3}\int_0^b y_1^3\,dx - \frac{1}{3}\int_0^b y_2^3\,dx \qquad (1)$$

The area of the shaded element in Fig. 4 in differential form is

$$da = \frac{s_1}{2}(s_1\,d\theta) - \frac{s_2}{2}(s_2\,d\theta)$$

$$= \frac{1}{2}(s_1^2 - s_2^2)\,d\theta$$

where s_1 and s_2 correspond to ρ_1 and ρ_2, respectively. Substitution of $k_1\,\rho_1^{3/2}$ for s_1 and $k_1\,\rho_2^{3/2}$ for s_2 gives

$$da = \frac{1}{2}\left[\,(k_1\,\rho_1^{3/2})^2 - (k_1\,\rho_2^{3/2})^2\,\right]d\theta$$

$$= \frac{k_1^2}{2}(\rho_1^3 - \rho_2^3)\,d\theta \qquad (2)$$

But the construction requires that $\rho_1 = y_1$ and $\rho_2 = y_2$, and these values substituted in Equation 2 produce the form

$$da = \frac{k_1^2}{2}(y_1^3 - y_2^3)\,d\theta \qquad (3)$$

Now, if in Fig. 1*a* the distance between A_0 and A_{24} is L, the relationship between any angle θ in radians on the polar graph, Figs. 2 or 4, and any horizontal distance x in inches on an irregularly shaped configuration, such as shown in Figs. 1*a* or 3, is

$$\theta = \frac{2\pi x}{L}$$

The differential form of this equation is

$$d\theta = \frac{2\pi}{L}\,dx \qquad (4)$$

Obviously, the distance L in Fig. 1 corresponds to 2π radians on the polar graph in Fig. 2. The value of $d\theta$ in Equation 4 substituted in Equation 3 gives

$$da = \frac{\pi k_1^2}{L}(y_1^3 - y_2^3)\,dx$$

Integrating

$$a = \frac{\pi k_1^2}{L}\int_0^b y_1^3\,dx - \frac{\pi k_1^2}{L}\int_0^b y_2^3\,dx \qquad (5)$$

Multiplying both sides of Equation 5 by $L/3\pi k_1^2$ gives

$$\frac{aL}{3\pi\,k_1^2} = \frac{1}{3}\int_0^b y_1^3\,dx - \frac{1}{3}\int_0^b y_2^3\,dx \qquad (6)$$

Since the right sides of Equations 1 and 6 are identical,

$$I = a\,\frac{L}{3\pi\,k_1^2}$$

This is the same equation that was used in the example to find the moment of inertia of an irregularly shaped plane figure rotating about a horizontal axis.

Tips and Techniques

Remembering Stress Formula

The relationship for the bending stress, f, in a loaded beam subject to bending moment, M, is given by

$$\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$$

where I = moment of inertia of the section; E = Young's modulus; R = radius at the neutral layer; and y = distance of the layer from the neutral layer. This useful formula can be easily remembered by using the mnemonic, May I Find You Ever Ready.—PREM J. BHATT, *Loughborough, England.*

Evaluating

DC Power Sources

By E. J. Laughlin
Westinghouse Electric Corp.
Buffalo

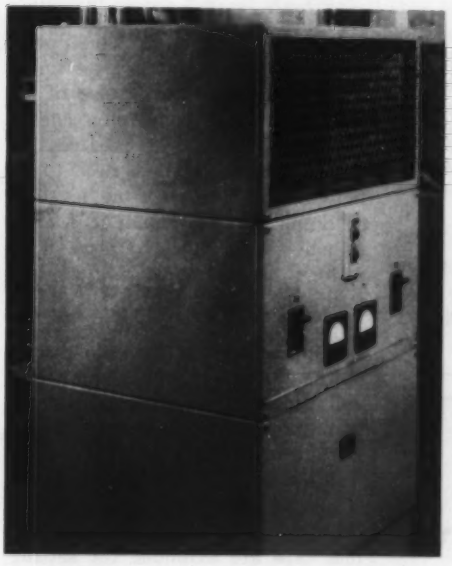


Fig. 1 — Silicon rectifier rated at 50 kw 250 v, which supplies dc requirements of a large boring mill in an adjustable - speed, constant - horsepower application.

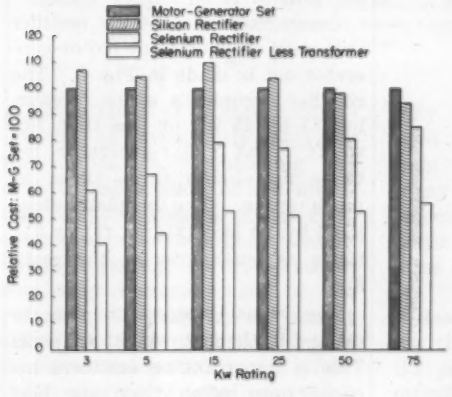


Fig. 2 — Comparison of initial cost of silicon rectifiers, selenium rectifiers and motor-generator sets rated from 3 to 75 kw. All comparisons are on a basis of dc output of 250 v, two-wire; ac input of 3-phase, 60 cycles, 460 v.

GENERALLY, the equipment that best meets modern conditions for converting ac to dc is the semiconductor rectifier. It may be the selenium type, which has been in use for over 15 years, or as more recent versions of the semiconductor rectifier, silicon or germanium units. For medium dc voltages any of these types may be used. Current opinion, however, is that silicon is to be preferred over germanium because of its high inverse voltage rating and its ability to operate at higher ambient temperatures.

Selection Factors: In selecting a suitable dc power supply, several important factors should be considered. Seven major points are: application; original cost; installation cost; maintenance expense; space and weight; quiet operation; and efficiency and light load losses.

Most applications of conversion equipment involve dc motors, magnetic chucks, solenoids, and dynamic braking. Of these, meeting power requirements for dc motors is doubtless the most pressing problem.

Type of speed control required often dictates the choice of power supply. If it is of the constant-torque, variable-voltage type, the motor-generator set is still predominantly used particularly for applications above 3 hp. But if the application requires constant horsepower, and speed control by adjustment of the dc motor shunt field, then an "on-the-spot" selenium or silicon rectifier is likely to be the answer. The unit shown in

Fig. 1 is typical of adjustable-speed, constant-horsepower applications; it is a 50-kw, 250-v silicon power unit supplying power to a large boring mill.

Where overhauling loads occur, such as in elevator equipment or for high inertia loads connected to a dc motor, dynamic braking control is available to work with the static rectifier to absorb this regenerated power. It cannot flow back through the rectifier.

Cost Comparisons: Comparative cost to the user of motor-generator sets and various types of semiconductor rectifiers is given in Fig. 2. It is seen that cost of selenium types is from 66 to 86 per cent of that of corresponding motor-generator sets. Although a comparison for only a few sizes can be shown, data for sizes falling between those listed are comparable. Furthermore, rectifiers are purchased as packaged units that require no external control. Optional items such as instruments, ac and dc hand-operated breakers, and indicating lights can be added to the package at a nominal cost.

A new unit introduced into this line-up costs less than half the price of motor-generator sets in most sizes. It is a selenium rectifier designed to operate directly from a 208/120-v, 3-phase, 60-cycle network without the use of a transformer. Dc output is approximately 255 v, 2-wire. Although these units are not likely to be widely applicable because there is no way to adjust the dc output, yet it does represent a low-cost means of power conversion wherever 208-v ac is available.

As shown, costs of silicon rectifiers are currently above those of selenium; this is mainly due to the added protection that designers feel is necessary with dc motor loads, but as experience is gained, this cost is certain to come down.

The packaged rectifier we know today is the least expensive of all types of power conversion equipment to install. It requires no foundation; it does not need to be bolted down; there is no leveling or lining up to be done; it is easy to move from place to place with a fork lift truck or any similar means of handling.

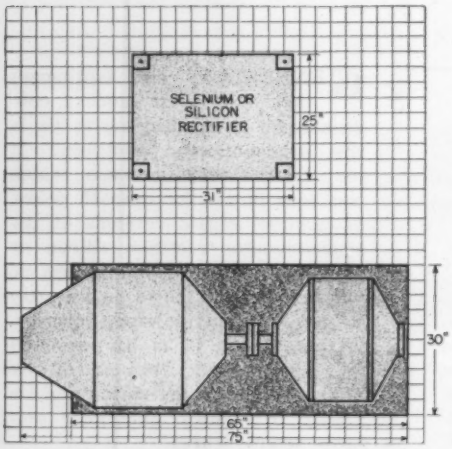


Fig. 3 — Floor space required by 50-kw power-conversion units. Rectifier unit requires less than 5½ sq ft; motor-generator set about 13½ sq ft.

Fig. 4 — Internal fan arrangement for a 100-kw rectifier unit. Noise volume is reduced by use of three fans instead of one large fan.

Application Factors: Since each power unit is set for its nameplate voltage at time of manufacture, installation requires only the connection of ac leads to the rectifier and the two dc leads to the load. If the ac supply voltage is higher or lower than the nameplate rating, taps are available for setting the dc output at the desired value. On standard units, limits of ac voltage setting is plus or minus 10 per cent of rated supply voltage.

Comparison of a 50-kw rectifier unit with an equivalent motor-generator set is made in Fig. 3. The rectifier occupies a space measuring 31 by 25 in., or less than 5½ sq ft. The motor-generator set takes up almost three times as much space. The bedplate alone is 65 by 30 in. (13½ sq ft) or 2½ times as much area as the rectifier.

The same comparison can be made for the net weight of each. This is important on rectifiers because very often they are best mounted on a shelf or a mezzanine

Table 1—Evaluation of AC-to-DC Power-Conversion Equipment

Requirements	Relative Merit* Rectifier Units Selenium	Silicon	Motor-Generator Set
Suitability:			
Fixed voltage	1	1	2
Variable voltage	2	2	1
Original cost	1	3	2
Installation cost	1	1	2
Maintenance expense	1	1	2
Space and weight	2	1	3
Quiet operation	1	1	2
Efficiency	2	1	3

*A rating of 1 indicates the best performance currently available.

floor, out of the way. Again comparing a 50-kw rectifier with an equivalent motor-generator set, the net weights are 2700 lb for the motor-generator set, and 1600 lb for the rectifier. In this case the rectifier is less than 60 per cent of the weight of a conventional motor-generator set.

Quiet operation receives increasing attention. Fig. 4 shows the internal fan arrangement for a 100-kw unit. Inclusion of three small fans rather than one large one not only improves reliability but also gains quietness. Since the fans are mounted inside with the blades away from any screened openings, air is brought in at the front of the unit where it is reasonably free from dirt and dust.

Attention is being directed toward efficiency, particularly since silicon and germanium rectifiers have come into the industrial picture. The silicon unit installed on the boring mill in Fig. 1 has a full-load efficiency of 90 per cent. At half load, efficiency is about 92 per cent, and remains high down to about one-quarter load.

Light-load efficiency of rectifiers is most important since in a normal day, a power supply operates frequently at no load or light loads. Rectifier no-load losses are normally less than half those of rotating equipment, for both silicon and selenium-type power supplies.

Evaluation: To summarize, Table 1 indicates relative strengths and shortcomings of three types of power-conversion equipment. Assignment of ratings of 1, 2 and 3 to indicate ability of each type to meet major requirements, gives an interesting though admittedly arbitrary evaluation. A rating of 1 indicates the best performance currently attainable. It is interesting to observe that six "firsts" are awarded to silicon equipment, five to selenium, and one to the motor-generator set.

From a paper entitled "Evaluating Packaged Direct Current Power Sources for Machine Tools" presented at the 21st Annual Machine Tool Electrification Forum, sponsored by Westinghouse Electric Corp., in Buffalo, April, 1957.

Limiting factors to consider in

Exploiting Inventions

By Walter C. Middleton

Patent Section
Central Office Staff
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Detroit

GRANTING of a patent covering an invention is not a key for automatically unlocking the door to exploitation of the invention. If the patentee cannot commercialize the invention himself, he may await approaches by others who may become aware of the patent, or he may try to interest others, such as manufacturers, in commercializing it.

Experiences of inventors in following the latter plan may explain why many patents never become used by anyone and the patentees gain no reward for their efforts. Many reasons have been given for rejecting patents so offered, of which the following are representative examples.

Reasons for Rejection: Assuming that the invention covered by the patent relates to an article of manufacture, such new articles must possess several qualities, such as utility, ease of manufacture, attractive price and the like, to gain success.

Even though the invention may be sound theoretically, often it will be found that in the form presented by the inventor it will not perform the function for which it was intended.

Investigation may prove that the potential market for a supposedly new article of manufacture is so small as not to warrant the cost of tooling for production and other necessary expenses for placing the article on the market.

If the patentee is in a position to commercialize his inventions himself, he will be well advised to have a patent investigation made by his patent attorney for the purpose of determining whether the way is clear for such commercialization. This investigation entails the study of unexpired patents in the same field and in fact is de-

terminative of the right of the inventor to manufacture, use, or sell his invention.

Patentees often are confused on this point since many believe that the grant of the patent automatically authorizes the patentee to make, use, and sell his invention. This was true particularly prior to 1953, since patents granted before that date included in the original patent delivered to the patentee the grant of the exclusive right to make, use, and sell the invention. Having such grant in his possession the patentee can be faced by the seeming paradox of having the exclusive right to make, use, and sell his invention, but being unable to do so without subjecting himself to possible suit for patent infringement.

Priority of Claims: This seeming paradox can be clarified by the following illustration. Reverting to bygone days, assume that someone of inventive mind felt the need for some article which would serve as a support in elevated position above a floor. This individual invented a table for which a patent was obtained. One of the claims of the patent—and patent claims measure the scope of the invention—might read as follows:

> As a new article of manufacture, a table comprising a member providing a generally plane surface, and a plurality of legs depending from said member for supporting said member in spaced relation to a supporting structure.

The table, being new, met with instant success, and the inventor automatically acquired to himself a ready market.

Having observed the utility of the table, another inventor conceived the idea of providing it with a movable tray, or drawer, in which various articles could be placed for concealment beneath the surface of the table but which would be readily accessible by moving the drawer outwardly from its position beneath the table. The support of this drawer could be by slideways, by pivotable connection, or by any other suitable arrangement. The second inventor, therefore, attempted to obtain a patent for his invention, and, since the new arrangement presented novelty, his efforts were rewarded by the grant of a patent. This second patent may have as one of its claims the following:

> As a new article of manufacture, a table comprising a member providing a generally plane surface, a plurality of legs depending from said member for supporting said member in spaced relation to a supporting structure, and a drawer secured to the undersurface of said member in such fashion as to be movable completely beneath said member and movable outwardly relative to said member for rendering the contents of said drawer accessible.

Analysis of the two claims from the two patents shows that the second inventor could not manufacture his improved table having a drawer under it without making a table meeting the description set forth in the claim of the first patentee. Furthermore, the first patentee can not manufacture the new table with the drawer without infringing the claim of the second patent. The second patentee could exclude everyone else from manufacturing his improved table but still was not free to manufacture it himself until the first patent expired. In this situation a license from the first patentee would permit the second patentee to make the new table, or cross licenses between the patentees would make it possible for each to make the improved article.

The courts in passing on patents have construed the provision of the statute which formerly granted to the patentee exclusive right to make, use, and sell his invention, as actually conferring upon him the right to exclude others from making, using, or selling the invention. This construction by the courts has now been incorporated in the patent statutes so that patents now clearly state that the inventor is granted only the right to exclude others from making, using, or selling the invention.

From "Some Problems Encountered in Exploiting Inventions" in General Motors Engineering Journal, *October-November-December*, 1956.

New designs for

Pressurized Metallic Seals

By George R. Keller and Paris H. Stafford

Autonetics Div.
North American Aviation Inc.
Los Angeles

METALLIC seals which will operate satisfactorily at temperatures well in excess of 500 F, contain pressures greater than 3000 psi, be capable of enduring a large number of thermal cycles and have leakage characteristics and service life at least as good as O-rings are being developed.

Seal Configurations: A number of metal seals which have potential use in hydraulic systems are shown in Fig. 1. These seals are all of the pressure-energized type. In this type, pressure differential is utilized to produce a more perfect seal. In addition, seals *b* and *c* have means for developing an initial interference fit so that the seals will not leak at low pressure.

Metal seals of the reed type are commercially available. These seals are truncated cones of metal, as shown in seal *a* of Fig. 2. Seal *b* of this figure is a lip seal of a type patented by J. Mercier. Seals *c* and *d* represent other configurations being tried by researchers in the field. These are all pressure-energized seals having an initial in-

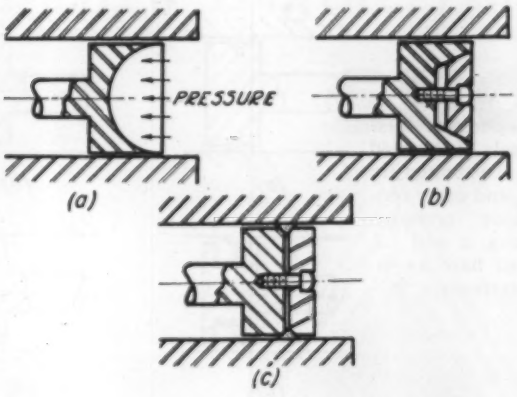


Fig. 1 — Pressure-energized metal seals. Seals *b* and *c* can develop an initial interference fit, thus preventing leakage at low pressure.

terference fit.

A complete analysis of any of these seals would have to consider the seal to be similar to a Belleville spring. Taking the configuration of Fig. 3 to be typical of the pressure-energized portion of each of the designs, it can be seen that the spring is uniformly loaded on one side by pressure. This loading is opposed by the cantilever restraint of the piston mounting and the reaction force on the cylinder wall.

In general, in the seals which have been considered in the metal-seal testing and evaluation program at Autonetics, a small included angle between the seal lip and the mating surface was deemed necessary. The lip of piston seals had to have allowable deflections great enough to allow for expansion of the cylinders under pressure. At the same time, the lips had to be stiff enough so that the internal moment would not produce stresses in excess of the elastic limit of the seals. The initial interference of the seams must be great enough to preclude leakage at low pressure, yet the total rubbing pressures between the sealing surfaces must not exceed the load-carrying capacity of the fluid films formed between the surfaces.

Seal Evaluation: The early stages of this evaluation program were confined to room-temperature testing of such configurations as the reed and chevron seals. Various combinations of materials, heat treats, surface finishes and thickness of materials were tried. A few tests were performed where the seal operated satisfactorily for approximately 20,000 cycles under load. However, the repeatability was very poor. Low-pressure leakage occurred in nearly all tests.

An examination of the seal failures indicated that some were due to galling while others could be attributed to excessive wear or permanent deformation of the sealing members. This indicated that extremely careful consideration must be given to the selection of materials and to the provisions for adequate lubrication of the sliding surfaces.

In the pressure-energized seal having an initial interference fit and whose configuration is similar to Fig. 2*c* and 2*d*, sufficient initial interference must be provided to prevent low-pressure leaks and to allow for radial expansion of the cylinder wall under pressure. However, excessive interference results in high breakout forces and reduces the chances of obtaining proper lubrication. It is felt that with this type of seal, moving at relatively low velocities, hydrodynamic lubrication is quite improbable even with fairly viscous fluids. As most hydraulic fluids have low viscosities at elevated temperatures, fluid wedges between the sealing surfaces are possibly never developed. The thin-film, or boundary lubrication, properties of the fluid then become quite important. It is also necessary to choose materials for the seals and mating surfaces which do not exhibit tendencies to gall while rubbing together under heavy pressure. Investigations are being carried out to determine the practicability of using a dry-film lubricant on cylinder bores and rods. Such a dry lubricant could possibly reduce the rates of wear or seizure currently encountered.

Test Results: Extensive testing on seals of these general configurations have indicated that seals whose surface hardness is low compared to that of the mating surface last longer under high-temperature testing than seals having harder surfaces. However, the comparative material hardnesses have not, as yet, been optimized.

The state of the art of the design of metal seals has advanced to a point where a room-temperature life of 100,000 to 200,000 cycles can reasonably be expected. However, the life span of any metal seal decreases markedly with increases in fluid temperature. As the fluid temperatures rise, failures due to wear, scoring and galling of the sealing surfaces occur more quickly. In addition to lowered fluid viscosity and surface tension, the loss of the gases adsorbed on the metal surfaces may be responsible for the increased rates of wear.

Considerable testing has been done with various configurations of metallic seals at oil temperatures in the 500 to 550 F range. In high-temperature tests conducted on metallic shaft seals having diameters from ¾ to 1½ in., the test actuator was cycled sinusoidally at a frequency of 2 cycles per second over a ¾-in. stroke. The actuator was loaded to simulate flight con-

ditions. A commercially available silicate ester hydraulic fluid was used. It was found that under these conditions a seal life of from 20,000 to 30,000 cycles may be expected at an oil temperature of 500 F.

The seal was considered to have failed when the leakage rate exceeded 1/25 of a drop per cycle. This limit corresponds to the requirement of paragraph 4.5.4 of specification MIL-C-5503B.

Metallic seals up to 3⅜-in. outside diameter have been tested as piston seals at both 500 F and 550 F. In the test of the larger diameter seals a different cycling method was used. In order to simulate a flight condition more nearly, the actuator was cycled in response to a random noise input signal. The integrated energy of the random input signal is related to the power spectral density of the expected gust loading. In tests of this type the number of hours of operation at temperature rather than the number of cycles of operation at temperature was used as the test criterion. These tests were run until such time as a sharp increase in leakage rate occurred. In the present state of development, the metal seals used in these tests operate for an average of 4½ hours at 500 F oil temperature. During the tests conducted at an oil temperature of 500 F, the average seal life has been approximately 2½ hrs.

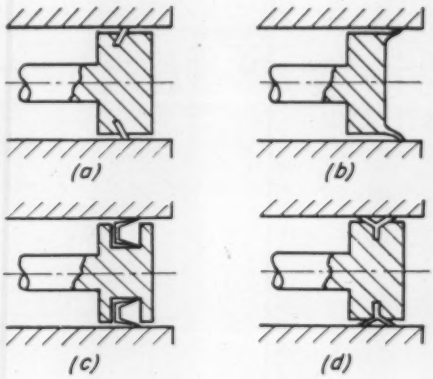


Fig. 2—Pressure-energized seals of the reed type, *a*, a patented lip type, *b*, and other configurations undergoing tests, *c* and *d*. These all have an initial interference fit.

Conclusions: It appears that the usable range of temperature and thermal cycling of elastomeric seals has been exploited fully. Additional requirements in terms of higher temperatures, greater temperature range, increased rate of thermal cycling and resistance to nuclear irradiation will probably have to be met with seals of metal or other nonorganic material. At the present time preloaded, pressure-energized metal seals appear to have the greatest promise.

In the absence of fluids having good high-temperature viscosity, seal materials should have nongalling characteristics, be strong, highly elastic and not too hard. The seal itself must be designed to withstand excessive deflection under pressure, yet be compliant enough to compensate for deflections of its mating surface. Forces between the sealing surfaces should always be great enough to preclude leakage at low pressure and never so great as to squeeze out all of the thin film of oil when activated by high pressure.

Two testing techniques are being used to evaluate these seals. One is an arbitrary cycling at a fixed frequency and stroke. In this method, leakage is measured as volume per cycle. The other method attempts to simulate more closely the duties of an actuator in a surface-control servomechanism. Here, leakage can only be a function of test time. With either technique of testing, elevated fluid temperatures result in shortened seal life.

It has been demonstrated that metallic dynamic seals can be made to operate in working hydraulic equipment under expected operating conditions. These seals are, as yet, marginal in their usability. However, so is every other type of seal proposed for high-temperature hydraulic use. There seems to be no basic technical obstacle preventing improvement in the design and operation of these seals.

From a paper entitled "Metal Dynamic Hydraulic Seals" presented at the SAE Annual Meeting in Detroit, January, 1957.

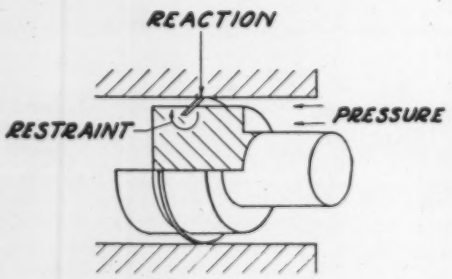
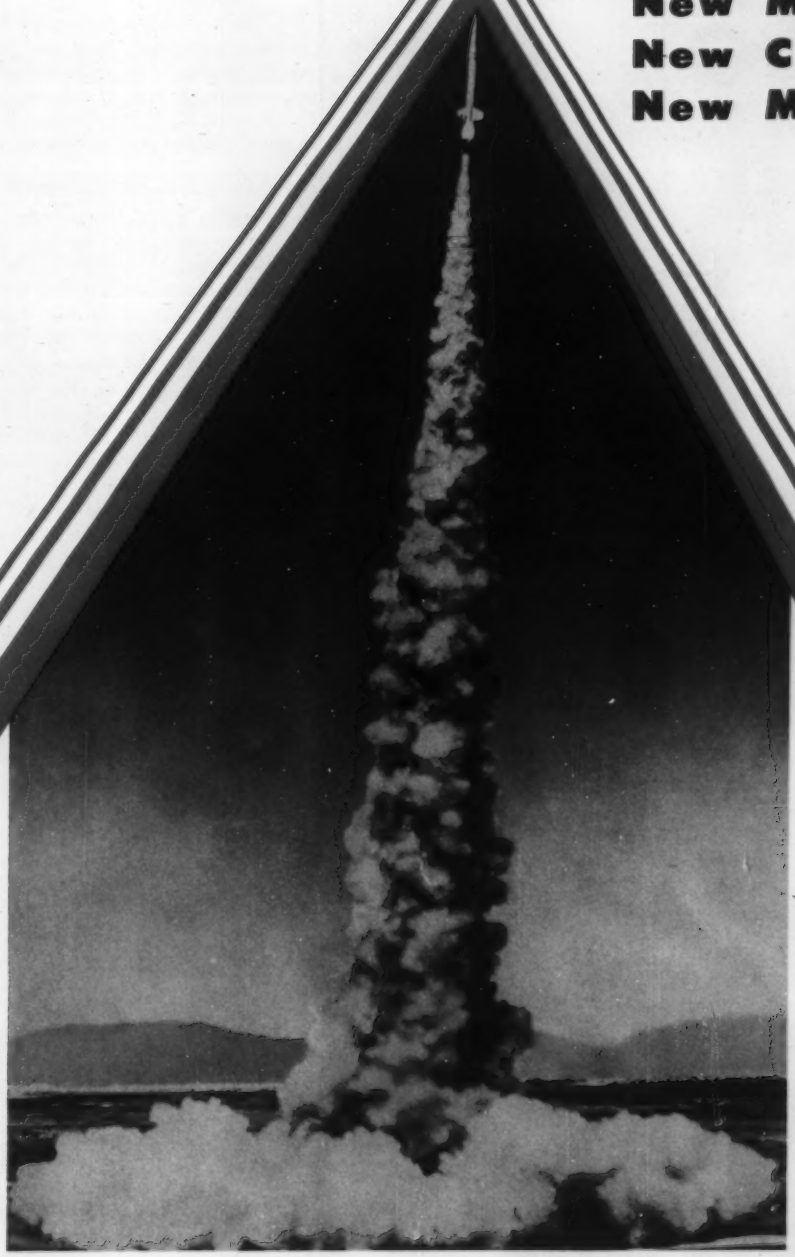


Fig. 3 — Typical configuration of pressure-energized seal and the forces acting upon it.

Design Engineering

SHOW GUIDE

New Ideas
New Methods
New Components
New Materials

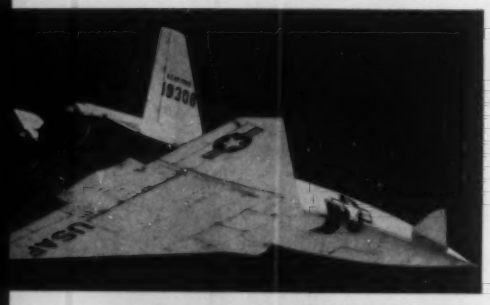


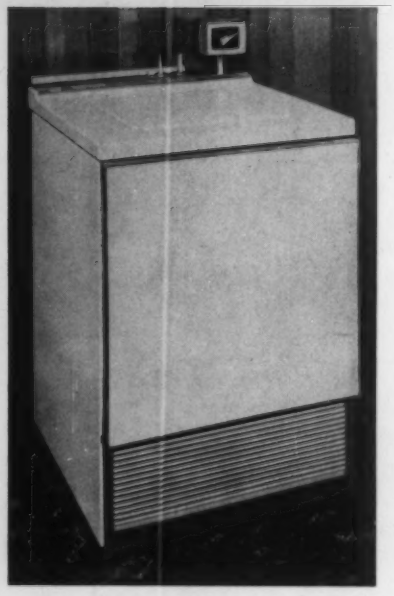
Second Design
Engineering Show
and Conference

May 20-23, 1957
New York Coliseum

Products for tomorrow . . .

1957 DESIGN





A MISSILE fires with a rumbling boom and a quick dying away of sound. A jet-powered racing boat slashes through the water with a surge of power. At the edge of outer space, a man-made satellite silently whips across the sky at meteoric speed.

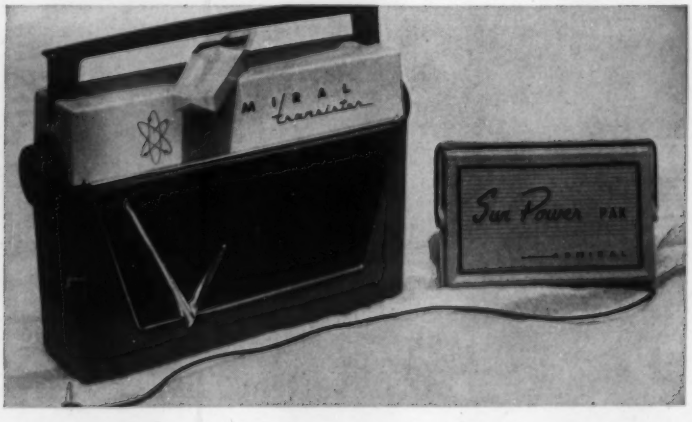
These are the dramatic symbols of today's engineering. They exist because dreams came true—translated into reality by men who specialize in converting dreams into practical accomplishments.

Design and development engineers work with the future. Their prime concern is products for tomorrow's world.

Design activity can range from the mathematically erudite analysis of a vibrating system to the practical problem of designing a low-cost casting. It can involve electrical or mechanical engineering, hydraulics, selection of materials, and many more engineering areas. But all design engineering has one objective: the development of an idea into a useful product.

The Second Design Engineering Show and Conference will provide a focal point for this common interest. Exchange of ideas on methods, components and materials is its key function.

In this Design Engineering Show Guide, the Editors of MACHINE DESIGN have gathered together all available information on the 1957 Show and Conference. Exhibitors, their products and booths are listed. A complete rundown of the Conference program will help engineers evaluate the sessions of interest. And a special pictorial section highlights new components and materials exhibited at the Show.



ENGINEERING SHOW

In This Section . . .

New Ideas from the Show ..... **Page 160**
A pictorial selection of 1956 and 1957 components, materials and processes.

New Ideas from the Conference **178**
Conference program and speakers, with short abstracts of papers.

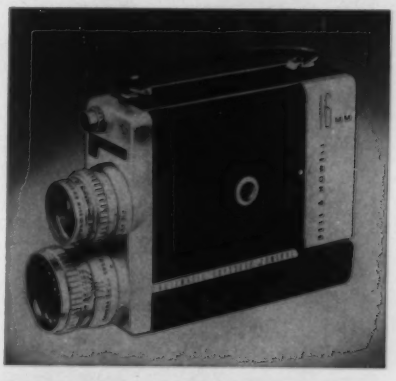
Where to Go **180**
Floor plans and "guide-book" information.

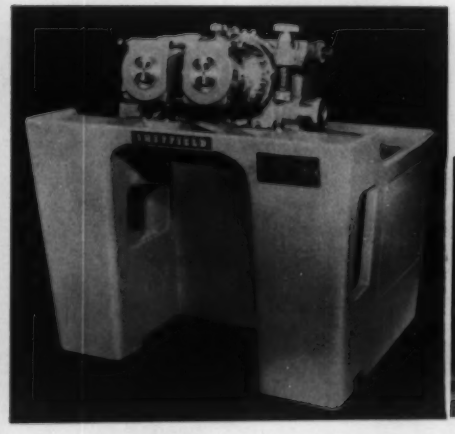
What to Look For **182**
Products exhibited by manufacturers; booth numbers; addresses.

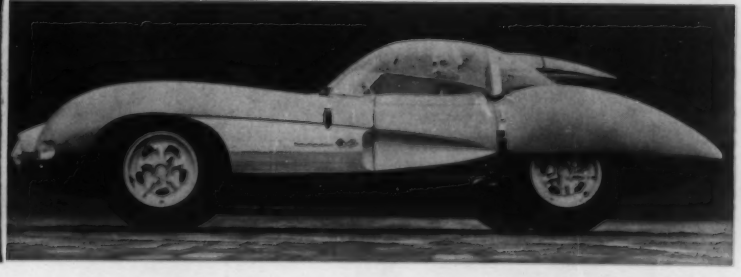
Quick Facts

Show: Runs for four days, May 20 to 23; occupies three floors of Coliseum, New York. Runs from 12 noon to 6 p.m.; registration fee, $2. Expected attendance, about 20,000 engineers. Over 350 exhibitors; 4000 company representatives. Second show to be held; first was in Philadelphia, 1956. Among five largest annual industrial expositions in U. S. See Pages 180 and 182 for further details.

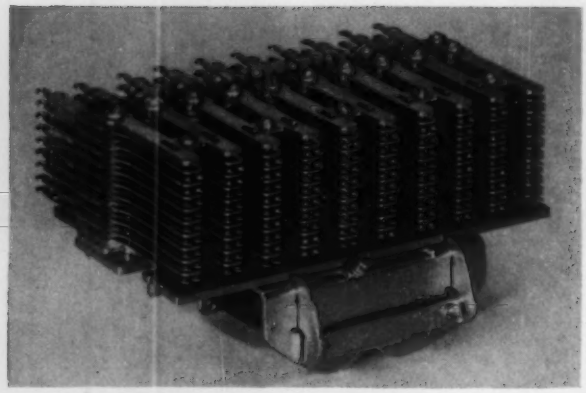
Conference: Runs for three days—mornings of May 20 to 22 on third floor of Coliseum. Sponsored by Machine Design Div., American Society of Mechanical Engineers. Registration fees: $5 for ASME members; $10 for nonmembers (includes copy of Conference proceedings). Discussions and papers will involve 33 speakers and discussion leaders. See Page 178 for further details.







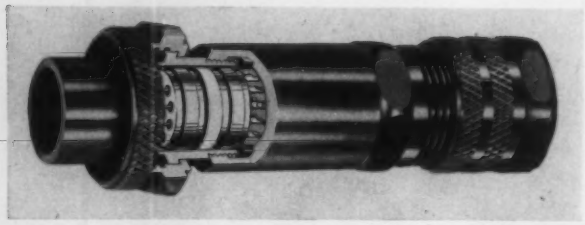
New Ideas • New Methods •



Operates 100 Contact Springs

Maximum of 100 Form A contact-spring combinations can be operated from 24 to 96 v dc coils. Special frame-armature construction of BB series relay prevents rocking or bending of armature under large spring load.—*Stromberg-Carlson Co., Booth 626.*

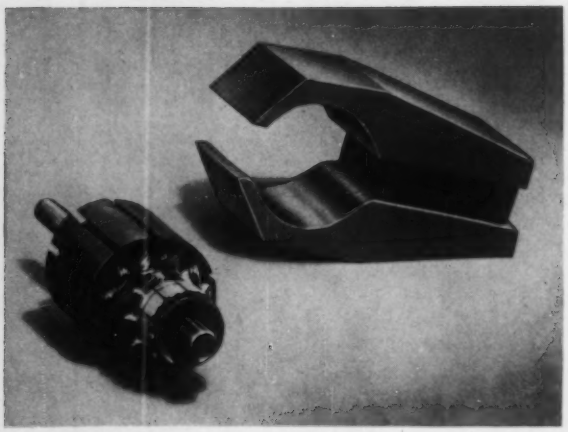
Circle 671 on Yellow Card



Connects 100 Electrical Lines

Resilient silicone laminate between floating rigid disks provides insulation in Neptune series connectors. Up to 100 No. 16 contacts are possible in 3-in. diam size.—*Pyle-National Co., Booth 614.*

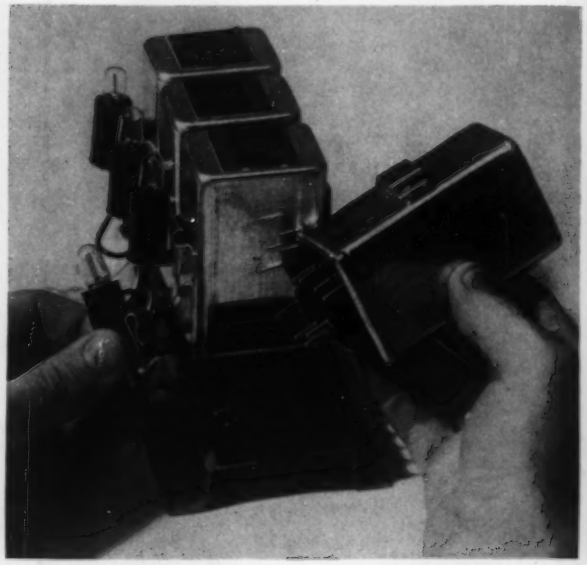
Circle 672 on Yellow Card



Control Without Moving Parts

Static control logic elements convert a combination of inputs into a single output to control machine functions. Used instead of relay systems, static controls have no moving parts. Monitor lights indicate operation; elements plug into base receptacle strip containing printed circuit.—*General Purpose Control Dept., General Electric Co., Booth 422.*

Circle 673 on Yellow Card

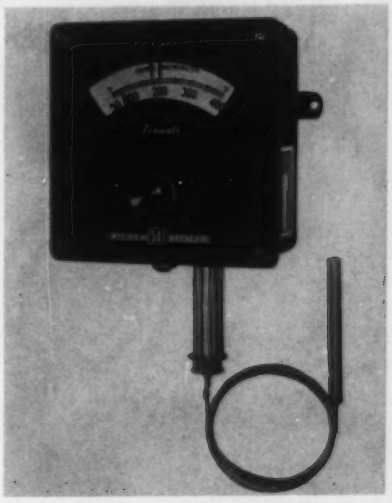


Powers Wound-Field DC Motors

New ceramic permanent-magnet material, Indox V, is said to be 3½ times more powerful than conventional ceramic magnets. Material can replace stator windings in wound-field dc motors.—*Indiana Steel Products Co., Booth 622.*

Circle 674 on Yellow Card

New Components • New Materials



Converts Analog Signal to Digital Control

Multicontact LIAD meter-relay replaces dial with printed-circuit scale segments. Low-current D'Arsonval coil positions a pointer over the scale. When a read-out coil is energized, a pusher bar moves the pointer into contact with the scale to transmit a digital control signal.—*Assembly Products Inc., Booth 1323.*

Circle 675 on Yellow Card

Measures and Controls Temperature

Bulb and capillary tube operates bellows assembly to indicate temperature. Snap-action switches provide on-off control at a fixed point, or operation at a fixed or adjustable temperature differential, depending on series 541 model used.—*Fenwal Inc., Booth 1414.*

Circle 677 on Yellow Card

Taps, Connects Shielded or Coaxial Cable

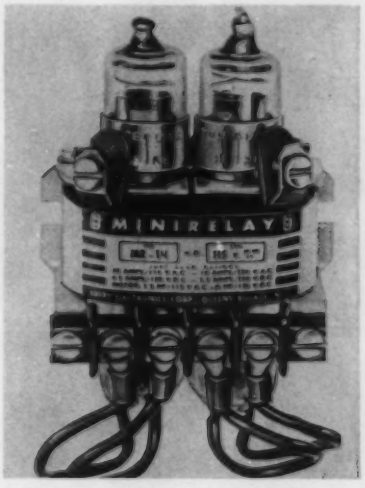
Fully insulated one-piece Uniring tap connector grounds, taps or connects shielded or coaxial cable.—*Burndy Engineering Co., Booth 1327.*

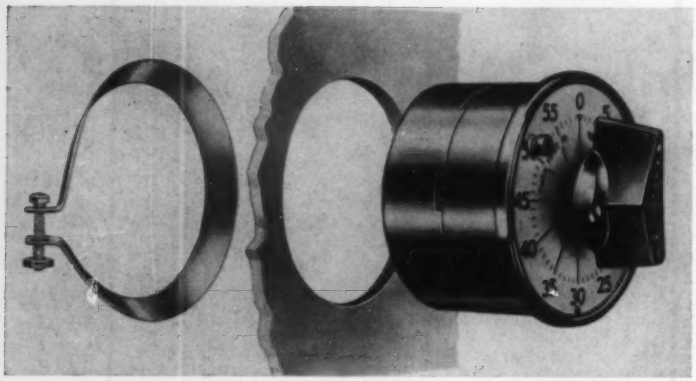
Circle 676 on Yellow Card

Uses Mercury Plunger for Relay Action

Double-pole, single-throw relay has hermetically sealed contacts with mercury-to-mercury contact action. Small size, dust and moisture resistance, and lack of wearing parts are features of MR-14 relay.—*Ebert Electronics Corp., Booth 1426.*

Circle 678 on Yellow Card

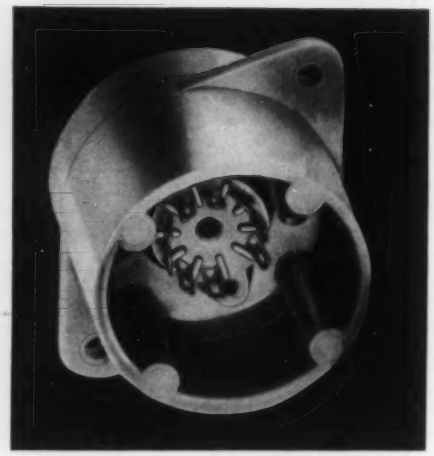




Mounts Through Panel

Mechanical timing device combines variety of timing cycles with choice of switching arrangements. Pushbutton lock release, adjustable stop, splash-proofing, pigtail switching leads, are features of 70,000 series.—*M. H. Rhodes Inc., Booth 636.*

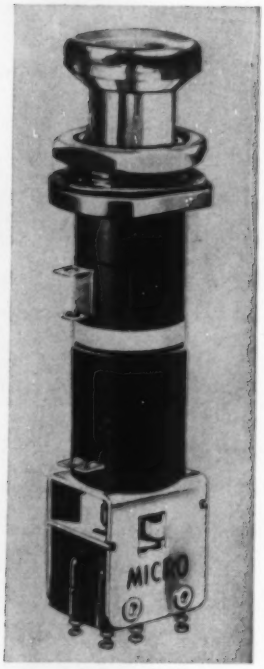
Circle 679 on Yellow Card



Protects Against High-Voltage Corona

Nine-pin electronic tube socket uses deep skirt extending far beyond terminals to avoid high-voltage corona discharge in miniaturized equipment such as portable television receivers. Socket has provision for shield-ring or center shield.—*Sylvania Electric Products Inc., Booth 110.*

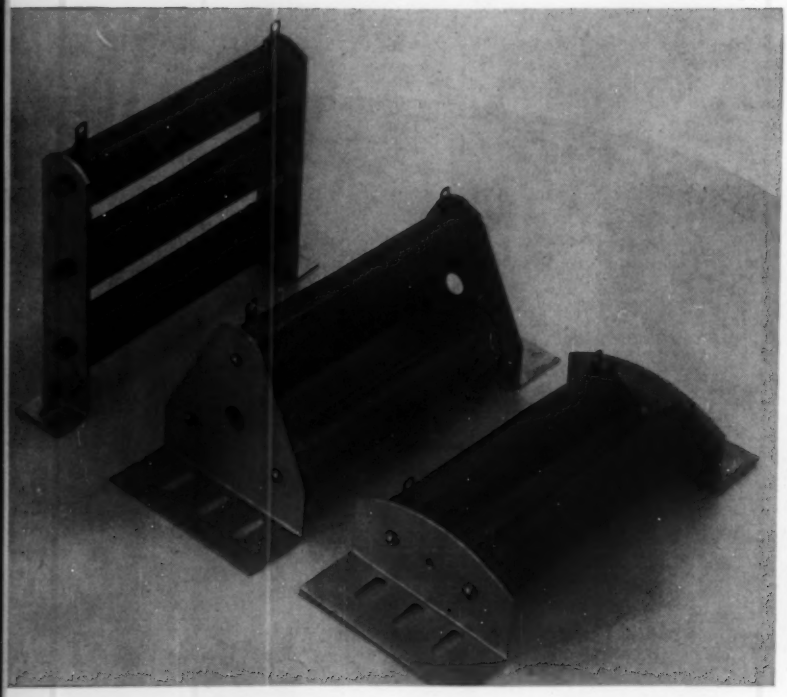
Circle 680 on Yellow Card



Combines Indicator Light and Switch

Lighted pushbutton switch is momentary type when a small built-in holding solenoid is not energized. When solenoid is energized, the double-pole double-throw switch stays in operating position when button is pushed. It may then be released electrically from any remote point.—*Micro Switch Div., Minneapolis-Honeywell Regulator Co., Booth 744.*

Circle 681 on Yellow Card



Resists Heat with Vitreous Enamel

Wire-wound resistors have ceramic body and vitreous enamel coating to provide high heat resistance. Ceramic body and complete encasement of wire by enamel withstand extreme temperature changes on electronic and industrial apparatus. — *Industry Control Dept., General Electric Co., Booth 422.*

Circle 682 on Yellow Card

Permits Plating Copper Printed Circuits

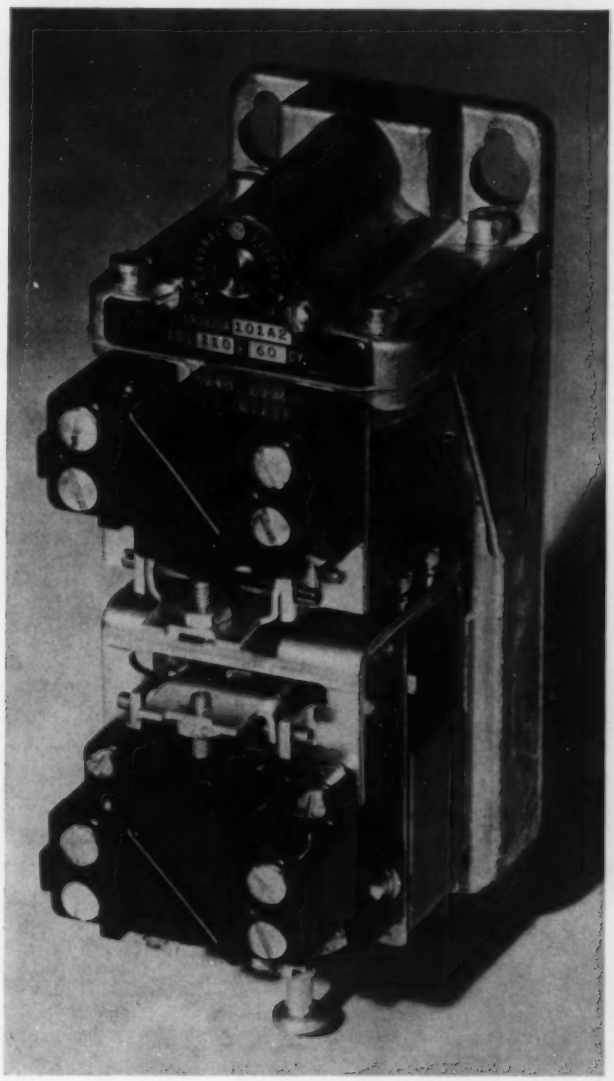
Adhesive-coated electrolytic copper sticks to printed-circuit base material in plating baths. For high grade printed circuits subject to extreme conditions, Plymaster type C allows plating of copper circuit with oxidation-resistant metal (silver, gold) in cyanide plating bath.—*Rubber & Asbestos Corp., Booth 6.*

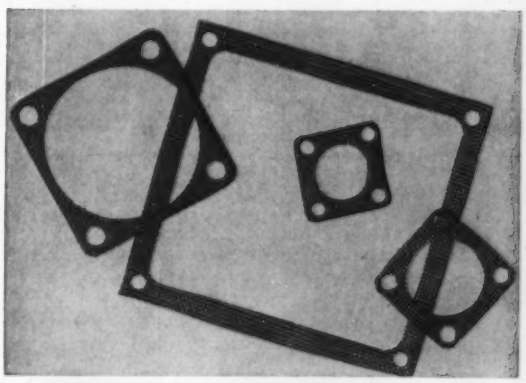
Circle 683 on Yellow Card

Converts DC to AC Signal

Microverter, a 60-cycle chopper, can convert low-level dc to low-level ac signal for further amplification to operate control apparatus. Also, as synchronous rectifier, can convert low-level ac signals to dc without loss.—*Barber-Colman Co., Booth 1329.*

Circle 684 on Yellow Card





Seals Out Air; Conducts Electricity

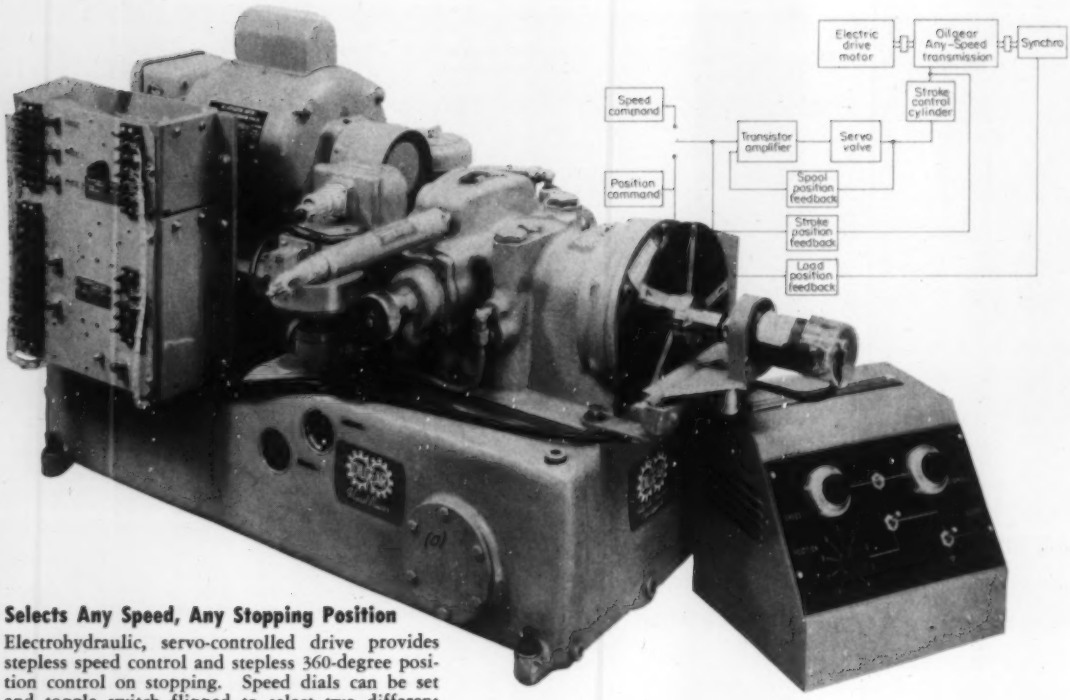
Conductive and shielding material is flexible aluminum wire cloth impregnated with neoprene. Used for gaskets, seals, shims and washers, Alu-Flex provides air-seal, yet conducts high-frequency currents. — *Auburn Mfg. Co., Booth 212.*

Circle 685 on Yellow Card

Delays Relay Action for Time Interval

Pneumatic time-delay relay has adjustable time delay from 1/5 to 180 sec with ±10 per cent repetitive accuracy. CR2820 unit provides snap-action timing contacts, with auxiliary instantaneous contact units in some forms. Available in general-purpose, watertight, and explosionproof enclosures.—*General Purpose Control Dept., General Electric Co., Booth 422.*

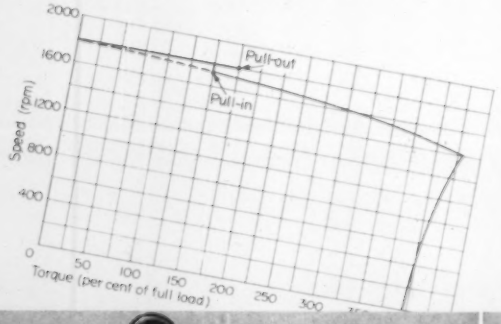
Circle 686 on Yellow Card



Selects Any Speed, Any Stopping Position

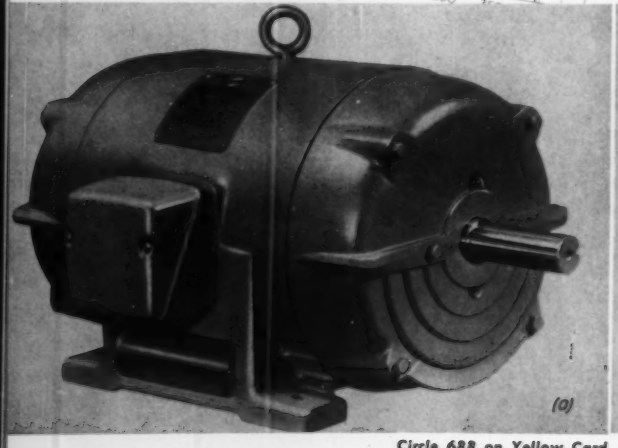
Electrohydraulic, servo-controlled drive provides stepless speed control and stepless 360-degree position control on stopping. Speed dials can be set and toggle switch flipped to select two different speeds in one direction, or any speed in one direction and another speed in the opposite direction. Reversal is available instantaneously. Speed dials may also be manually adjusted to change speed. Instantaneous stopping position control available from preset dial position by flipping toggle switch. —*Oilgear Co., Booth 1740.*

Circle 687 on Yellow Card

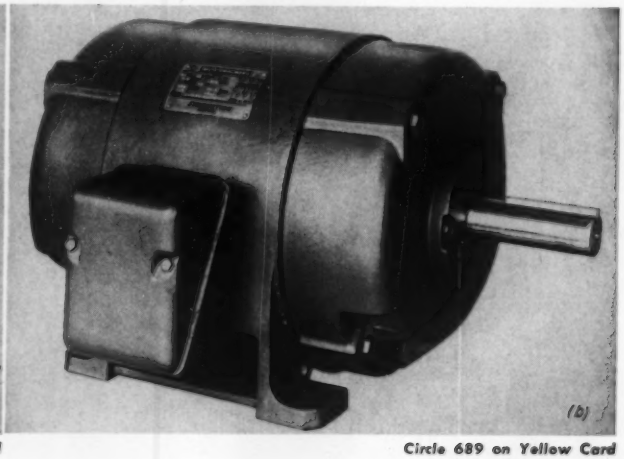


Combine Simplicity, Synchronous-Speed Operation

Synchronous-induction motors run at exact synchronous speed without slip from no load to pull-out. Accelerating like induction motors, synchronous-induction types require no external dc excitation or permanent magnets. Efficiency is high, approaching that of squirrel-cage motor of similar size; across-the-line starters can be used for control. Simple construction is feature. —*a, Syncro Spede* motor, Louis Allis Co., *Booths 417, 419; b,* Synduction *motor, Allis-Chalmers Mfg. Co., Booth 1730.*



Circle 688 on Yellow Card

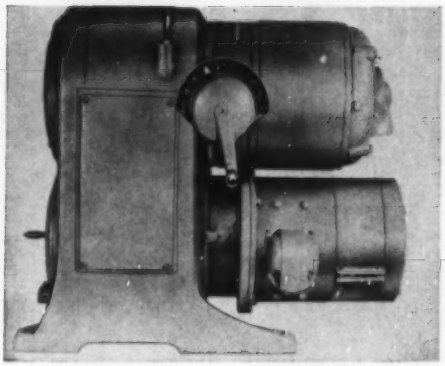


Circle 689 on Yellow Card

Converts AC to DC to Control Motors

Packaged Selectrol power-conversion unit obtains variable speed of one or more driven motors by ac to dc conversion. Motor-generator set supplies variable dc voltage for 5 to 125-hp, 8:1 to 16:1 speed variations. Stepless speed range, controlled acceleration, and regenerative braking are features. Modifications include reversing control, dynamic braking, and jogging control.—*Electro Dynamic Div., General Dynamics Corp., Booth 712.*

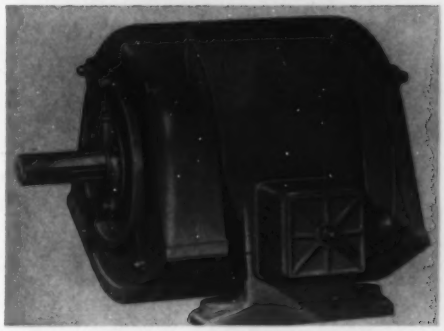
Circle 690 on Yellow Card



Varies Frequency to Change Drive-Motor Speed

Speed changes in one or more 60-cycle, three-phase ac squirrel-cage motors are controlled by varying frequency supplied to motor. Handwheel on Varidyne power unit controls speed of alternator driven by constant-speed motor. Alternator generates a frequency proportional to its speed to control drive motors from 1/3 to 30 hp. Speed ranges from 1 to 10,000 rpm are possible in ratios to 5:1.—*U. S. Electrical Motors Inc., Booth 1644.*

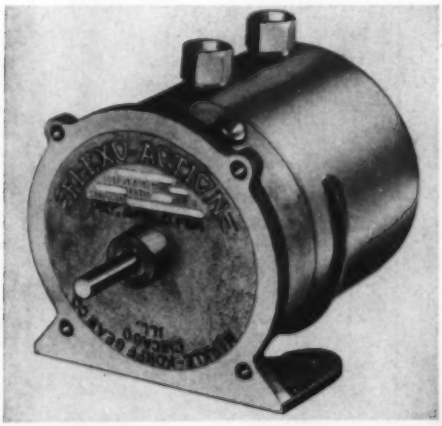
Circle 691 on Yellow Card



Offers Choice of Three Horsepowers

Single motor provides three horsepower ranges by a change of wires in conduit box. Built for outdoor duty, motors are squirrel-cage, 60-cycle, polyphase, 220/440 v ac types for 900, 1200 and 1800 rpm synchronous speeds. Example: frame 444 motor provides 30, 20 or 12 hp.—*Brook Motor Corp., Booth 23.*

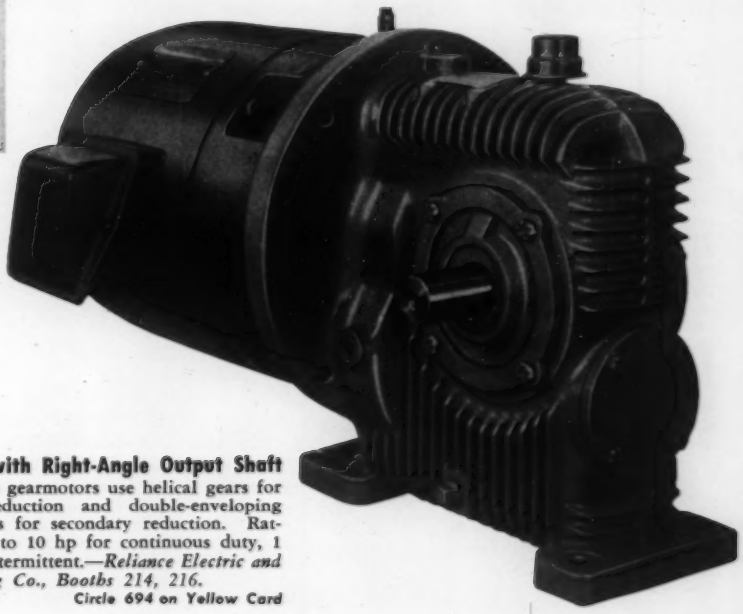
Circle 692 on Yellow Card



Provides Small Sealed-Package Reduction

Fractional-horsepower gear-reducer motors combine sealed gear case with totally enclosed or enclosed-ventilated motors. Intermittent ratings are 4 lb-in. at 800 rpm to 30 lb-in. at 10 rpm. Spur gears are hobbed, heat-treated steel.—*Merkle-Korff Gear Co., Booth 1317.*

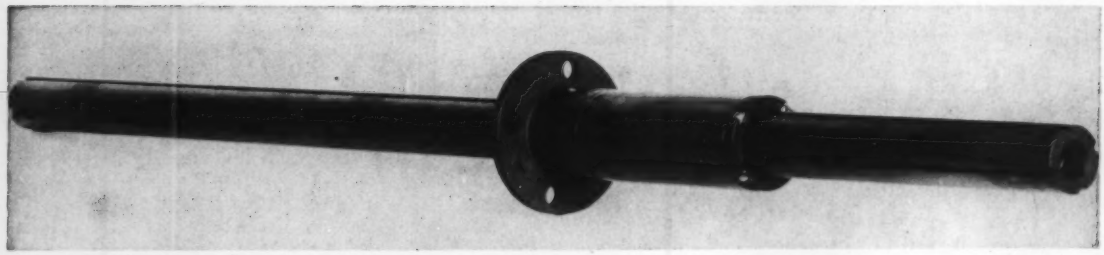
Circle 693 on Yellow Card



Saves Space with Right-Angle Output Shaft

Right-angle gearmotors use helical gears for primary reduction and double-enveloping worm gears for secondary reduction. Ratings are 1 to 10 hp for continuous duty, 1 to 30 hp intermittent.—*Reliance Electric and Engineering Co., Booths 214, 216.*

Circle 694 on Yellow Card



Slides Axially: Transmits Rotation

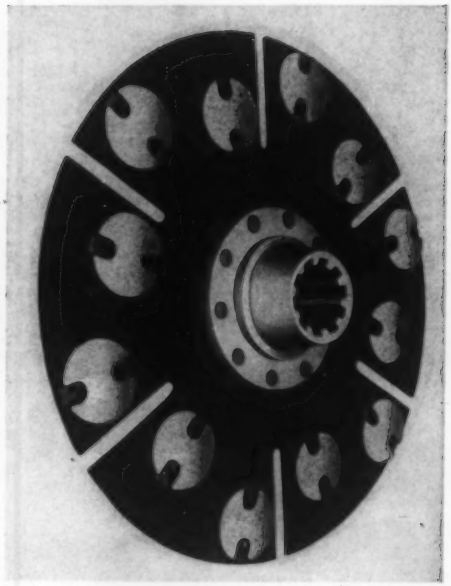
Ball-bearing spline rolls freely in axial direction, but transmits rotational power. Splined shaft member can be any length.—*Beaver Precision Products Inc., Booth 324.*

Circle 695 on Yellow Card

Removes Squeaks, Squeals or Chirps

QVD fractional-horsepower V-belt has special rubber compounds in cover fabric to eliminate noise. Elastic strength member absorbs shocks and guards against over-tensioning responsible for vibration and belt noise. Outer-cover rubber compounded to prevent dusting off of finely powdered rubber. —*Dayton Rubber Co., Booths 519, 521.*

Circle 696 on Yellow Card



Delivers Uniform Friction Action

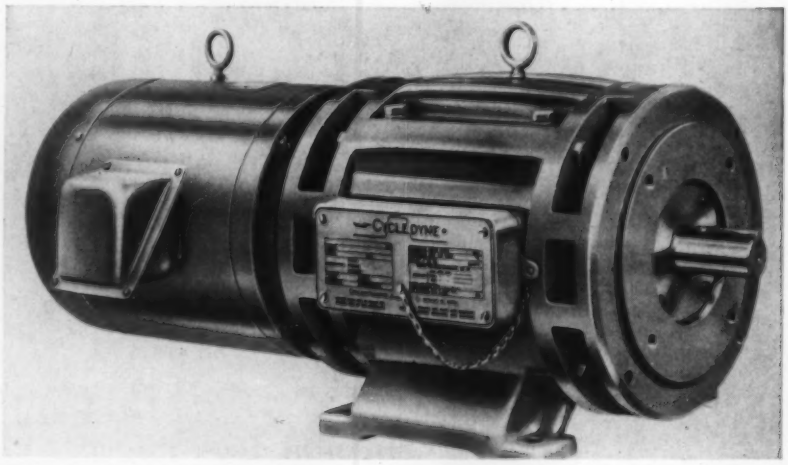
Heavy-duty clutch plates are fitted with multiple buttons made of sintered copper with wear-controlling ceramic elements. Buttons are not encased in steel cup; only friction material contacts the clutch pressure plate.—*S. K. Wellman Co., Booth 12.*

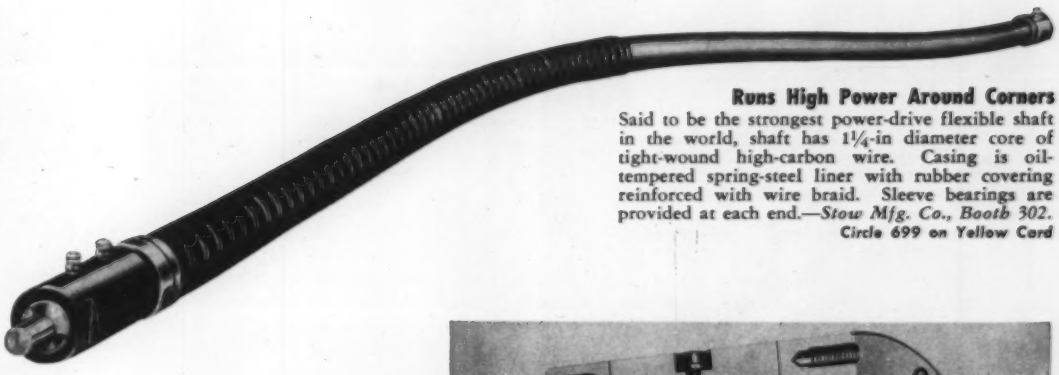
Circle 697 on Yellow Card

Starts, Stops, Inches, Positions, Holds

Cycledyne mechanical power transmission unit handles all cyclic machine control operations—starting, stopping, inching, positioning—yet operates from a constantly running motor. During power transmission part of cycle, unit operates without slippage or power loss. Low-current electromagnetically controlled unit, operating like a clutch-brake combination, also provides acceleration, deceleration, and torque-limiting control. Flywheel action permits fast machine cycling rates without excess drive motor size.—*Cycledynamics Inc., Booth 1227.*

Circle 698 on Yellow Card

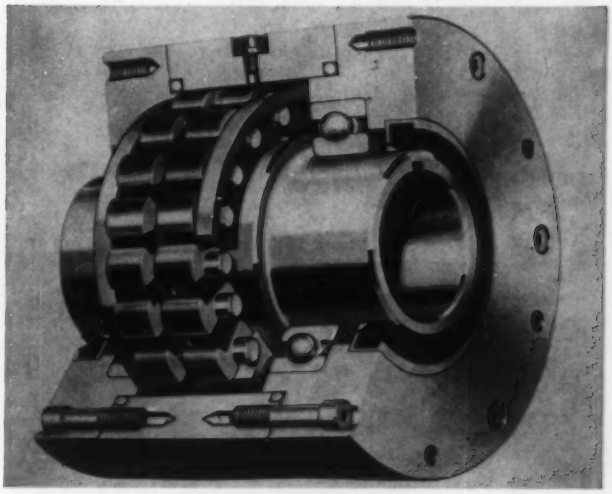




Runs High Power Around Corners

Said to be the strongest power-drive flexible shaft in the world, shaft has 1¼-in diameter core of tight-wound high-carbon wire. Casing is oil-tempered spring-steel liner with rubber covering reinforced with wire braid. Sleeve bearings are provided at each end.—*Stow Mfg. Co., Booth 302.*

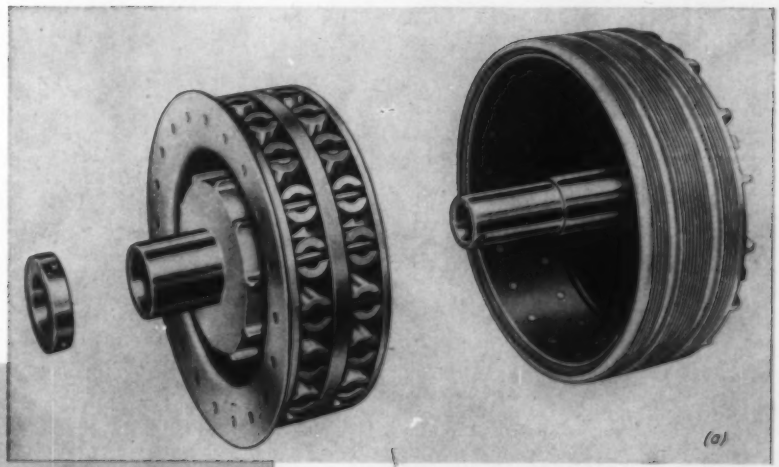
Circle 699 on Yellow Card

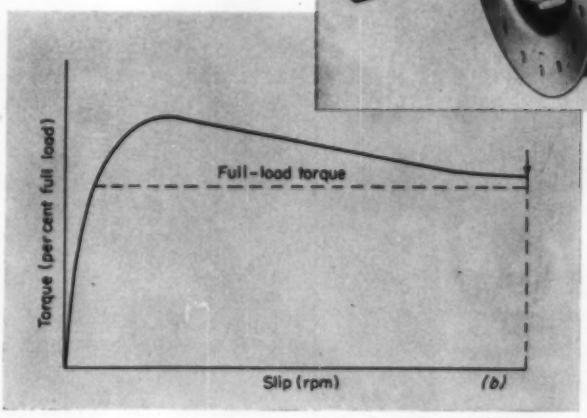


Overruns, Indexes and Backstops

Double ball-bearing sprag clutches are sealed to prevent contamination by abrasive particles. Overrunning clutch capacities are 1875 to 11,600 lb-ft; indexing and backstopping clutches, from 3160 to 11,600 lb-ft. —*Formsprag Co., Booth 208.*

Circle 700 on Yellow Card

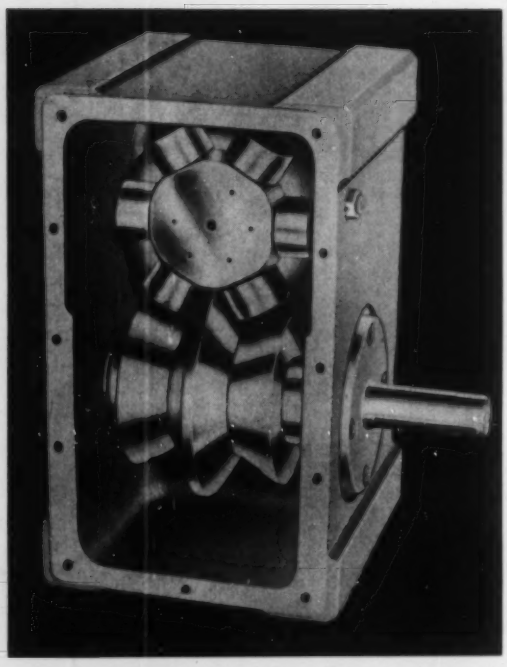




Transmits Power with Permanent Magnets

Self-contained Whitney-Tormag magnetic drive provides cushioned start, motor overload protection, and shock cushioning at 95 per cent drive efficiency. Slip is approximately 100 to 120 rpm. Bimetallic copper-faced mild-steel drive rotor never contacts magnetic rotor containing Alnico V permanent magnets. Drive can run at full stall (100 percent slip) indefinitely without harming motor or coupling.—*Whitney Chain Co., Booth 322.*

Circle 701 on Yellow Card



Indexes 2000 Times a Minute

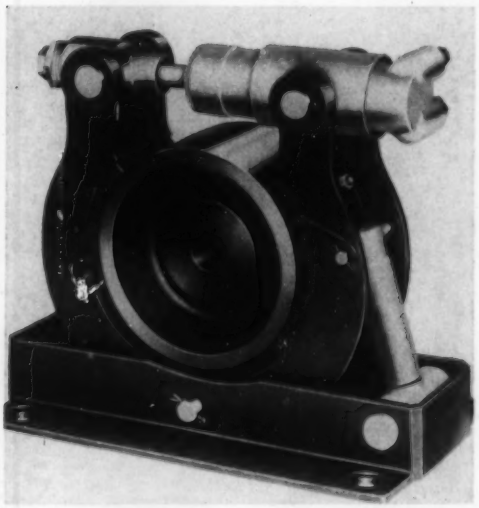
Small, high-speed, E-series roller-gear indexing drives provide 3 to 12 stops with indexing periods of 120, 180 or 270 degrees. Precision is 0.001-in.; backlash is zero. Modified trapezoid acceleration characteristic gives smooth, vibration-free indexing at rates to 2000 indexes per minute.—*Ferguson Machine Corp., Booth 306.*

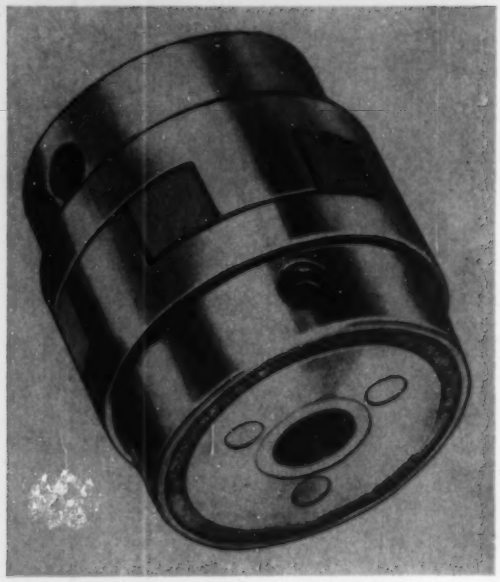
Circle 702 on Yellow Card

Brakes by Hydraulic Action

Service or parking brakes are actuated by hydraulic cylinder. Size is 6 by 3 in.—*Wagner Electric Corp., Booths 522, 524.*

Circle 703 on Yellow Card

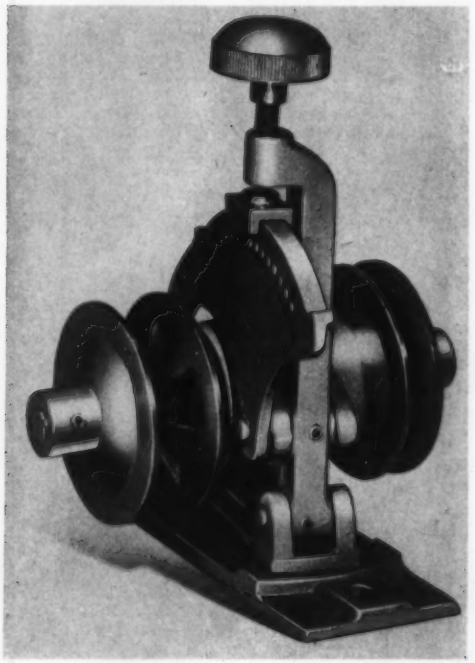




Couples Misaligned Shafts at Low Cost

Zinc die-cast flexible coupling is designed for low-cost original equipment installation. L-093 coupling consists of two bodies with one-piece six-ended spider-type cushion. Cushion can be resilient Buna N rubber, leather, Bakelite, or Bakelite with Buna N center.—*Lovejoy Flexible Coupling Co., Booth 113.*

Circle 704 on Yellow Card



Provides 10:1 Speed Range

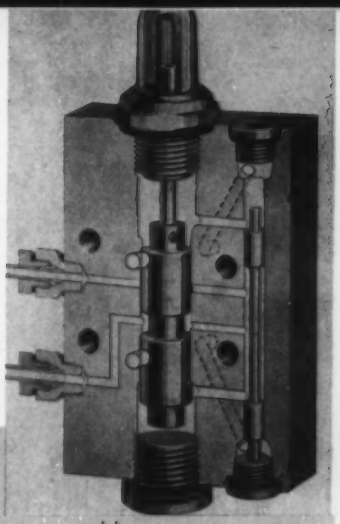
V-belt adjustable-speed transmission handles 7½ hp. Automatic self-aligning feature keeps V-belts in alignment.—*Maurey Mfg. Corp., Booth 731.*

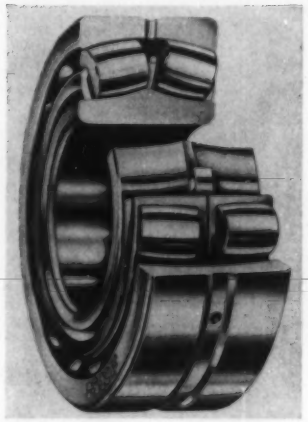
Circle 705 on Yellow Card

Permits Misalignment Without Damage

Heavy-duty self-aligning bushings permit misalignment with high static loads or intermittent oscillation under load. Bushings are of SAE 52100 steel hardened to Rockwell C60 to 63 and coated with molybdenum disulfide. Outer race is fractured to accept ball and kept integral with snap ring.—*Roller Bearing Co. of America, Booth 933.*

Circle 706 on Yellow Card

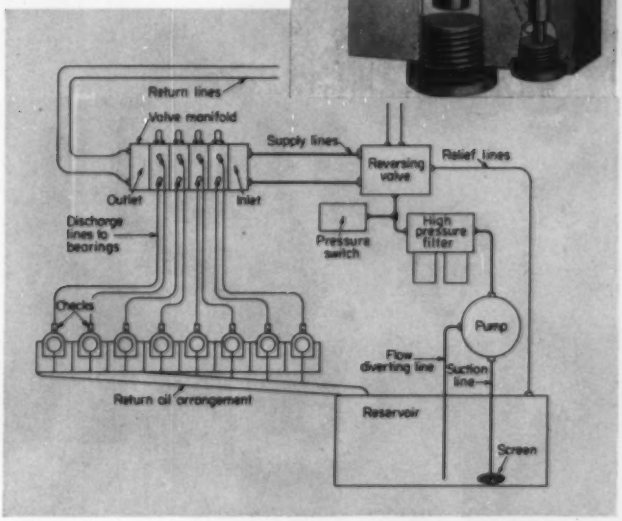




Flushes Bearing with Lubricant

Improved spherical roller bearings have holes in outer ring to feed lubricant to center of bearing and flush away old lubricant, dust, dirt, and moisture. Lubricant supply groove in OD of outer ring can mate with lubricant fitting in housing.—*SKF Industries Inc., Booth 705.*

Circle 707 on Yellow Card



Warns of Broken or Clogged Lubricant Lines

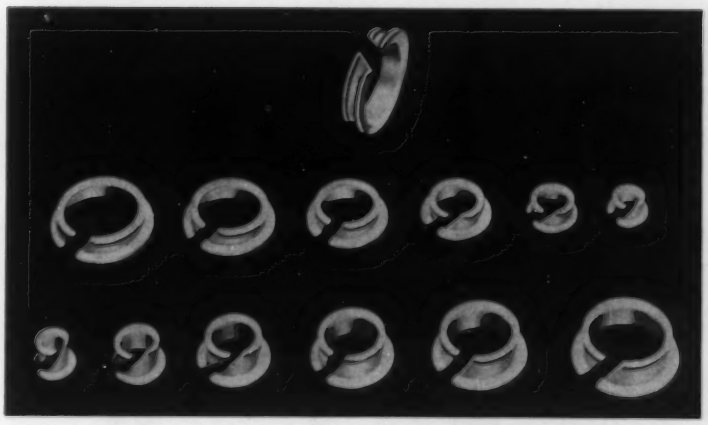
Lubrival centralized lubrication system senses line pressure to warn of clogged or broken lines in any part of the system. Variable-delivery pumping unit permits wide variation in number of injections per minute supplied to bearing points by metering valves (shown). Any number of metering valves can be manifolded together.—*Farval Corp., Booths 222, 224.*

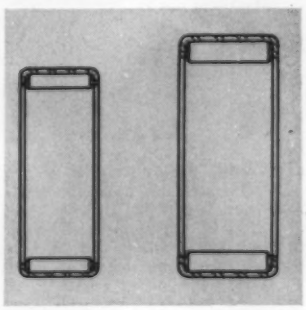
Circle 708 on Yellow Card

Improves Needle-Roller Load Capacity

Thin-shell needle-roller bearing uses spherical-end rollers for maximum area of contact and high capacity. Rollers are SAE 50100 steel and shells are SAE 1010; both are hardened to Rockwell C60. Rounded roller ends present smooth surface contact with shell. — *Kaydon Engineering Corp., Booth 1724.*

Circle 709 on Yellow Card





Snaps Bearing into Sheet-Metal Hole

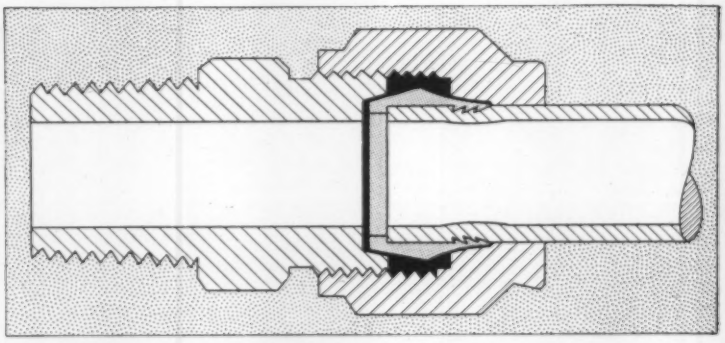
Nylon bearing with flange on each end snaps into sheet metal or thin plates. Snap-in Nyliners take radial loads plus thrust loads in one direction. Helical compensation grooves permit expansion and contraction of nylon without change in bore diameter; also allow anchoring flange to pass through mounting hole.—*Thomson Industries Inc., Booth 432.*

Circle 710 on Yellow Card

Makes Butt Joint with Tubing

Hi-Seal flareless fitting eliminates need for springing tube in making assemblies, and flaring or welding. Especially suited for hydraulics applications, fitting is easily used with large-size, heavy-wall or hard-temper tubing, or short tubing lengths.—*Imperial Brass Mfg. Co., Booth 944.*

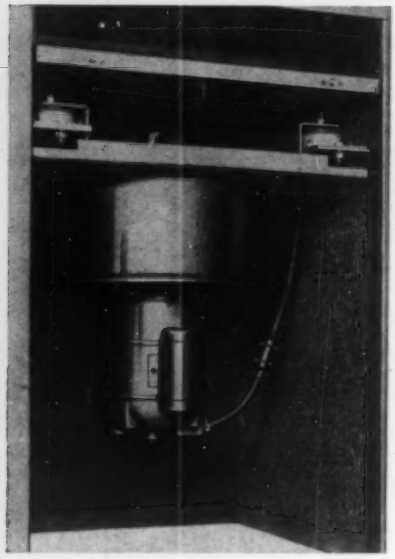
Circle 711 on Yellow Card

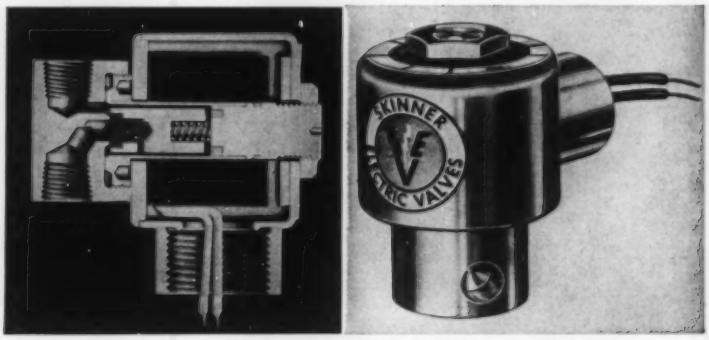


Furnishes Constant Air Supply or Vacuum

Low-cost centrifugal blower supplies constant air flow or vacuum. HD unit available in four sizes from ½ to 1½ hp.—*Lamson Corp., Booth 722.*

Circle 712 on Yellow Card





Features Low-Cost Solenoid Control

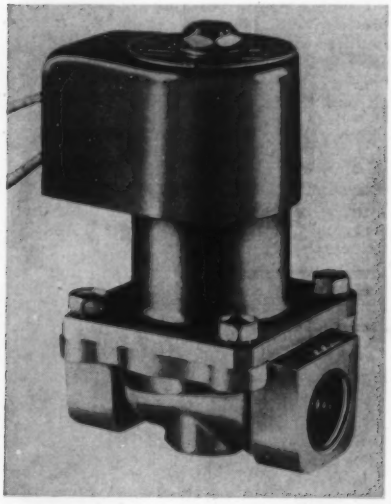
Brass-bodied fluid control valve has only two moving parts. C-series solenoid valve is packless, direct-acting type with spring closure. Pipe size is ⅛-in. NPT, for pressures from 60 to 130 psi.—*Skinner Electric Valve Div., Skinner Chuck Co., Booth 708.*

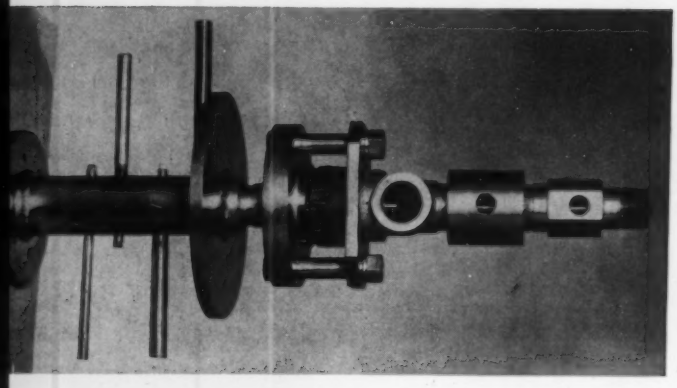
Circle 713 on Yellow Card

Runs Four Passages into Rotating Equipment

Four-way revolving joint can carry four separate fluids into rotating equipment. Air, hydraulic or steam pressure to 1000 psi, and right or left-hand rotation, can be handled. Rotating inner members are stainless steel; joint is preloaded so any runout of largest rotating member will not strain inner members.—*Rotherm Engineering Co. Inc., Booth 402.*

Circle 714 on Yellow Card

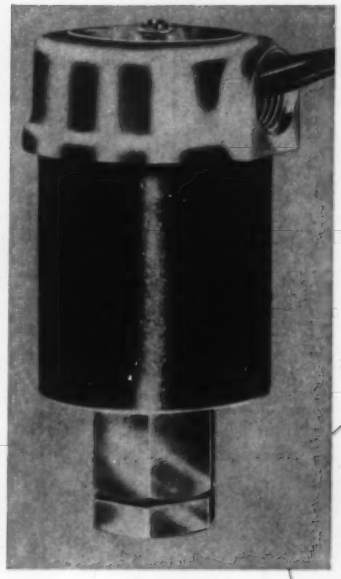


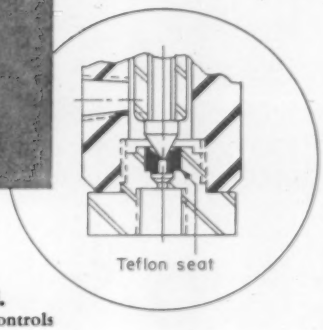


Controls Steam, Hot Fluids or Gases

Packless solenoid valve controls steam, hot fluids or hot gases to 400 F. Pilot-operated Bulletin 8222A valve uses Teflon disks for tight shutoff.—*Automatic Switch Co., Booth 1204.*

Circle 715 on Yellow Card





Holds Pressures to 5000 psi.
Stainless-steel solenoid valve controls high gas pressures in low-flow applications. Type SBTDW valve is direct-lift, angle type machined from Type 316 stainless-steel bar stock for corrosion resistance. Handles light gases to viscous liquids. Pipe sizes, 1/8 or 1/4-in.—*Atkomatic Valve Co. Inc., Booth 1807.*

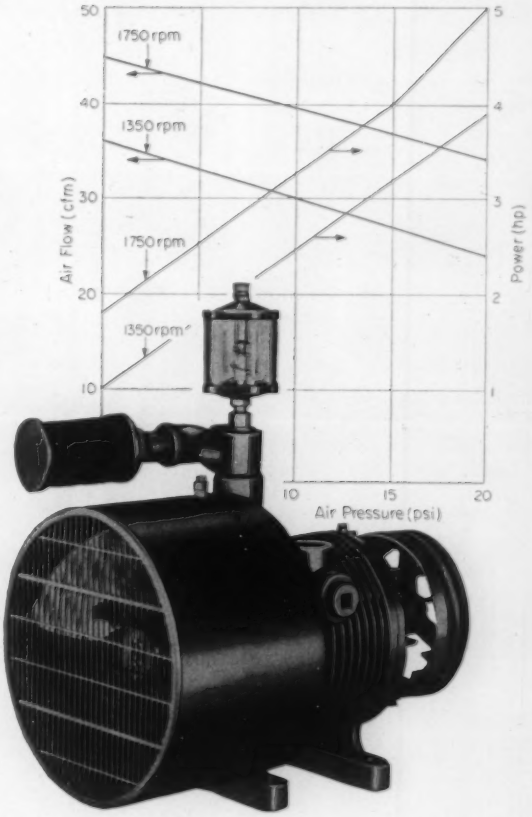
Circle 717 on Yellow Card

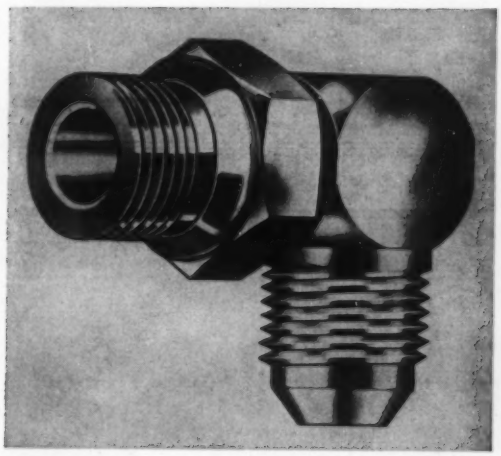
Withstands High Operating Pressures
Ermeto 7000 series flareless tube fittings provide high-pressure seal with SAE O-ring boss without backup rings. Weathercote finish resists nonflammable as well as petroleum-base fluids. Operates from −65 to 212 F.—*Weatherhead Co., Booth 332.*

Circle 716 on Yellow Card

Doubles as Compressor or Vacuum Pump
Rotary-vane air pump delivers 45 cfm, twice the capacity of former models. Unit is air-cooled by externally mounted fan. As compressor, unit delivers 20 psig continuously at 1750 rpm with 5-hp motor; vacuum to 25 in. mercury with 3-hp motor.—*Gast Mfg. Corp., Booth 1828.*

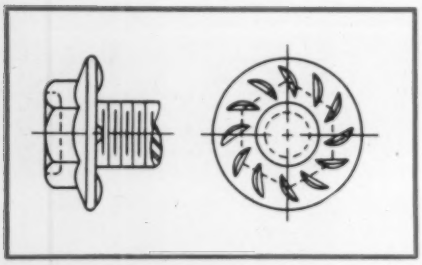
Circle 718 on Yellow Card





Seals Without O-Rings
Captive-nut straight-thread fittings mate with simple 30-degree angle port contour. Fluid seal is positive even with vibration. Type CN fitting can be reused.—*L & L Mfg. Co., Booth 231.*

Circle 719 on Yellow Card



Prevents Thread Stripping

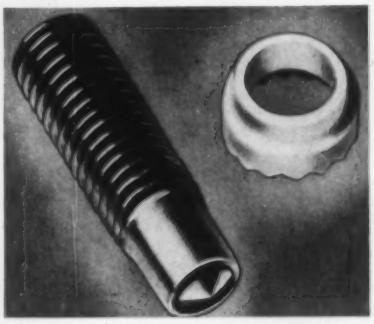
Nibs under head of thread-cutting Nibscrew act as brake to stop screw when head contacts outer sheet; prevent overstressing inner sheet. Driving torque is unchanged, but stripping torque is much higher than with conventional heads. Broad range of driver settings is permitted—*Shakeproof Div., Illinois Tool Works, Booth 1312.*

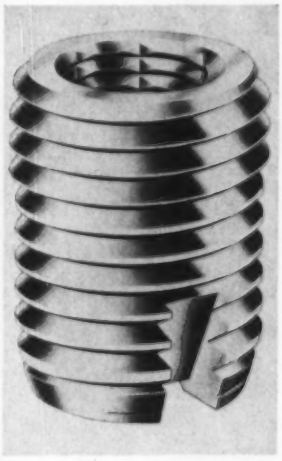
Circle 721 on Yellow Card

Develops Strong Weld to Base Metal

Type CP threaded stud has larger weld base diameter to develop full strength of threaded section of stud. Diameters available from ¼ to ⅜-in.—*Nelson Stud Welding Div., Gregory Industries Inc., Booths 326, 328.*

Circle 720 on Yellow Card

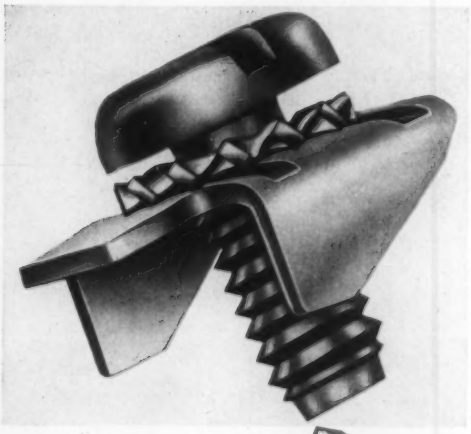




Holds Tight Grip on Circuit Wires

Terminal clamps have serrated multitooth lock washer for positive contact and fastening of electrical wires. Clamp base fits standard openings in terminal strips and control panels. Made in one piece, clamp offers fast assembly.—*Eaton Mfg. Co., Reliance Div., Booths 938, 940.*

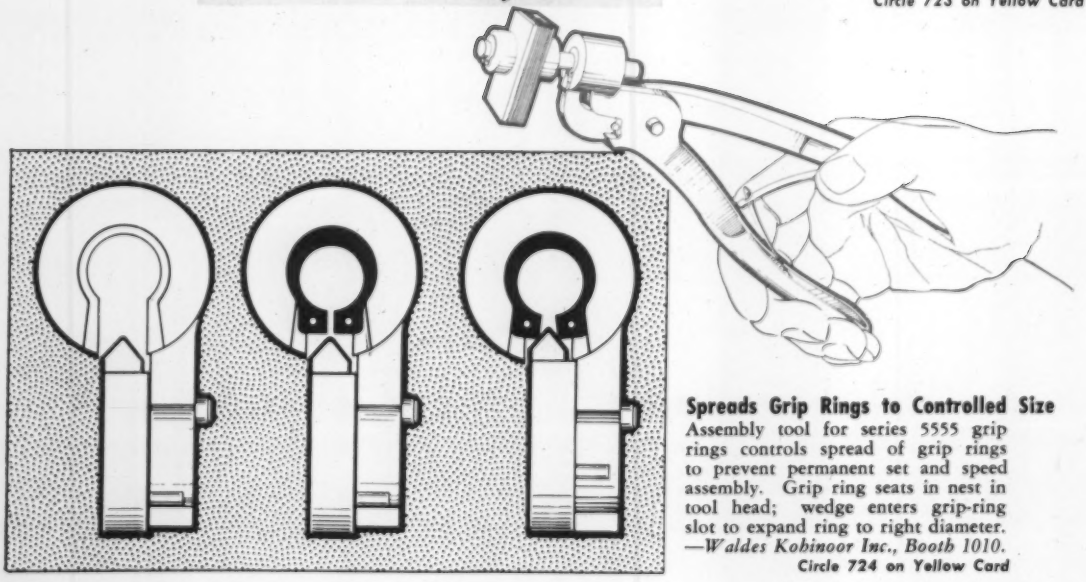
Circle 722 on Yellow Card



Self-Taps, Locks in Light Metals

Self-tapping insert provides National Standard steel threads in aluminum or magnesium. Driven by hex bar or tool, Inserto cuts its own thread in drilled or cast holes. Combination of truncated and full-diameter threads creates interference lock in parent material.—*Rosan Inc., Booth 806.*

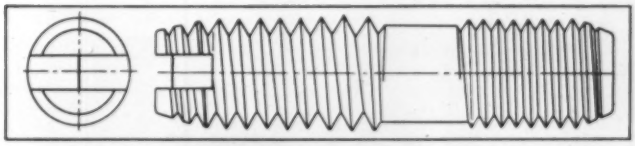
Circle 723 on Yellow Card



Spreads Grip Rings to Controlled Size

Assembly tool for series 5555 grip rings controls spread of grip rings to prevent permanent set and speed assembly. Grip ring seats in nest in tool head; wedge enters grip-ring slot to expand ring to right diameter. —*Waldes Kohinoor Inc., Booth 1010.*

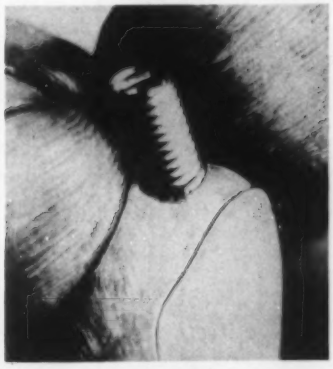
Circle 724 on Yellow Card



Taps Own Threads; Locks in Place

Schweppe stud cuts own threads and locks by interference. Can be used in blind drilled holes; drill-point hole and double slot in stud provide chip space. Stud can be located from slotted end for automatic feeding.—*Pheoll Mfg. Co., Booth 623.*

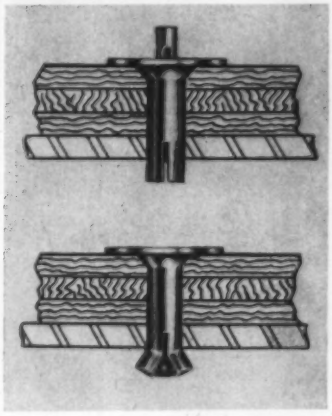
Circle 725 on Yellow Card

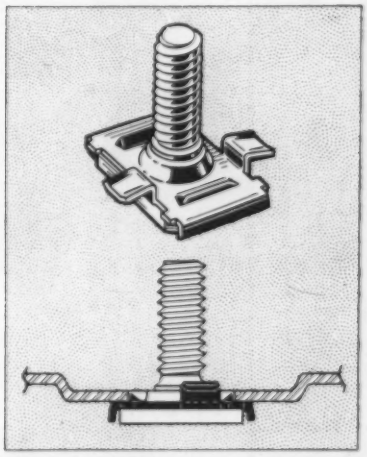


Provides Locking Threads for Small Screws

Miniature 4-40 self-locking wire-thread insert uses integral gripping coil to lock screw. Stainless-steel Screw Lock insert can be used in light metals, plastics, steel, and cast iron.—*Heli-Coil Corp., Booths 310, 312.*

Circle 726 on Yellow Card





Tips Into Square Mounting Hole

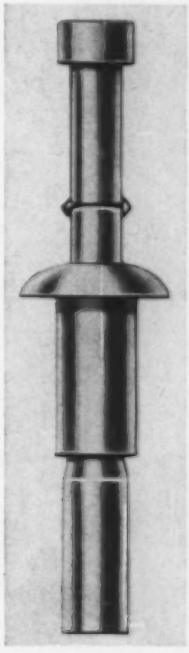
Bolt retainers tip into square mounting hole from front side, are locked in place as they are drifted into perpendicular position. Enough float is allowed in C31031-1420 retainer for normal manufacturing tolerances. Simple tubular tool, or bolt itself, can serve as drifting device.—*Tinnerman Products Inc., Booth 1001.*

Circle 727 on Yellow Card

Fastens Plywood with Hammer Blow

Ply-Head blind rivet has large under-head bearing area for installing plywood and composition board. Rivet is inserted from front through drilled hole; hammer blow drives pin flush, expands rivet end, and pulls members together in firm grip.—*Southco Div., South Chester Corp., Booth 1239.*

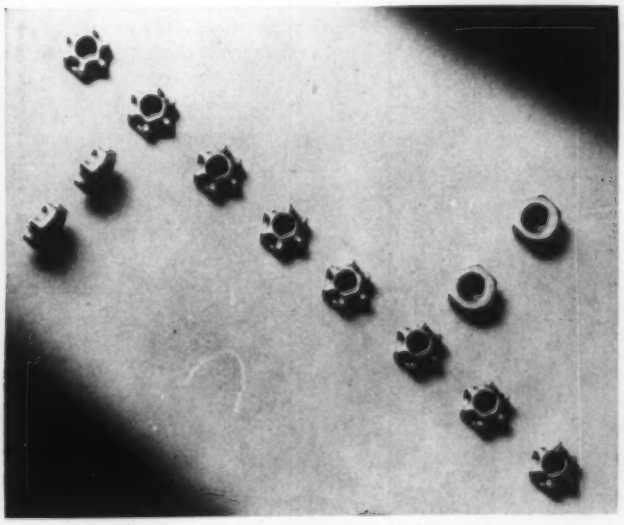
Circle 728 on Yellow Card



Expands to Clinch Assembly

Two-part Versa-Rivet installs from one side in thicknesses to ⅜-in. Stem in hollow rivet is pulled by gun tool to expand rivet shank, filling hole and pulling material together. Protruding stem is trimmed flush with hand or power trimmers. Material is 2017 aluminum.—*Townsend Co., Booth 1139.*

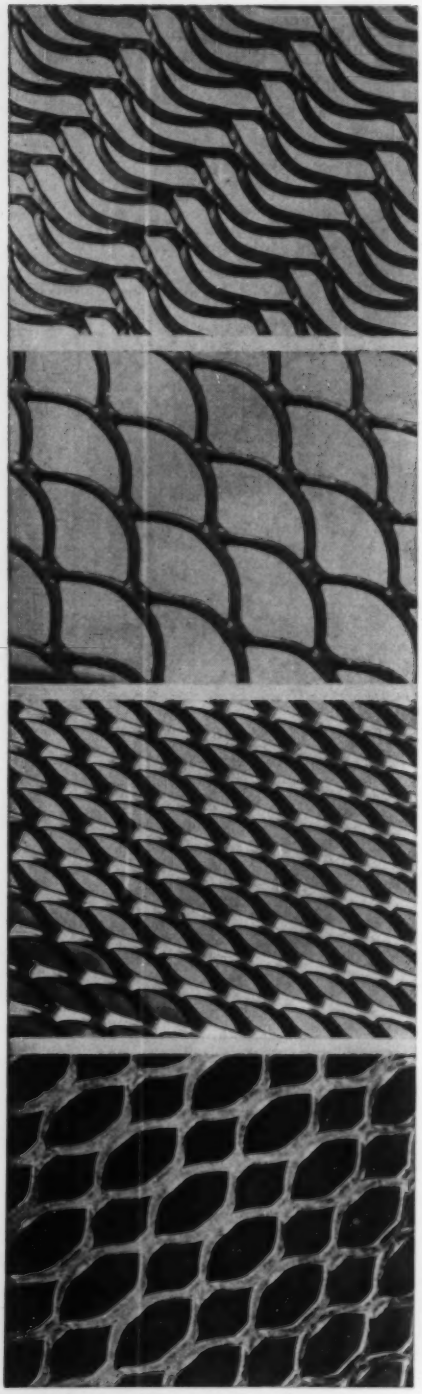
Circle 729 on Yellow Card



Reduce Weight 43 Per Cent

Steel locknuts are 43 per cent lighter than conventional types with same holding power. Can be used as locknuts or jam nuts, have full wrenching area. Intended for aircraft and aircraft instruments, at temperatures to 550 F, locknuts are available in 10-32 and ¼-28 sizes.—*Standard Pressed Steel Co., Booths 416, 420.*

Circle 730 on Yellow Card



Combine Appearance and Strength

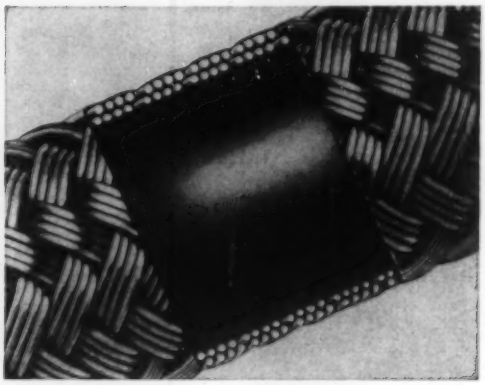
Expanded metals in dramatic patterns lend advanced design appearance, yet have greater rigidity than parent metal. Available in aluminum, carbon steel and, in some meshes, stainless steel.—*United States Gypsum Co., Booth 1501.*

Circle 733 on Yellow Card

Flexes Under Tough Conditions

Teflon flexible hose assemblies stay flexible from −100 to 450 F. Lightweight, they resist any known acid, fuel, or oil within temperature range. —*American Brass Co., American Metal Hose Div., Booth 828.*

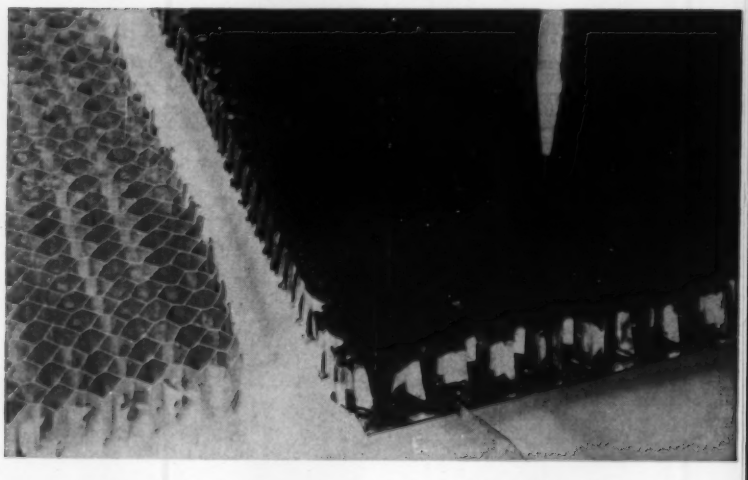
Circle 731 on Yellow Card



Produces High-Strength Honeycomb Sandwiches

Epoxy resin adhesive has exceptionally high shear strength at 300 F, resists water and salt spray, and can be cured with or without a catalyst. Self-filleting properties plus lack of volatiles make it ideal for honeycomb structures. Without catalyst, EC-1469 adhesive meets MIL-A-5090 B and can be used with unperforated honeycomb material.—*Minnesota Mining and Manufacturing Co., Booth 1106.*

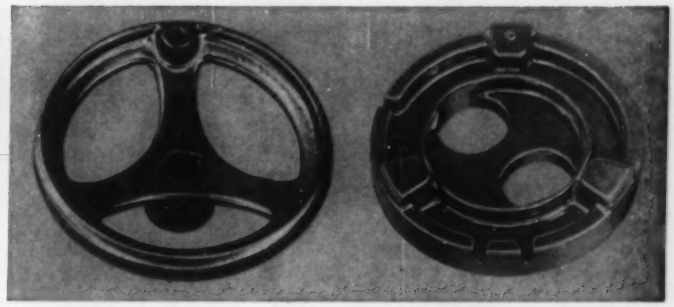
Circle 732 on Yellow Card

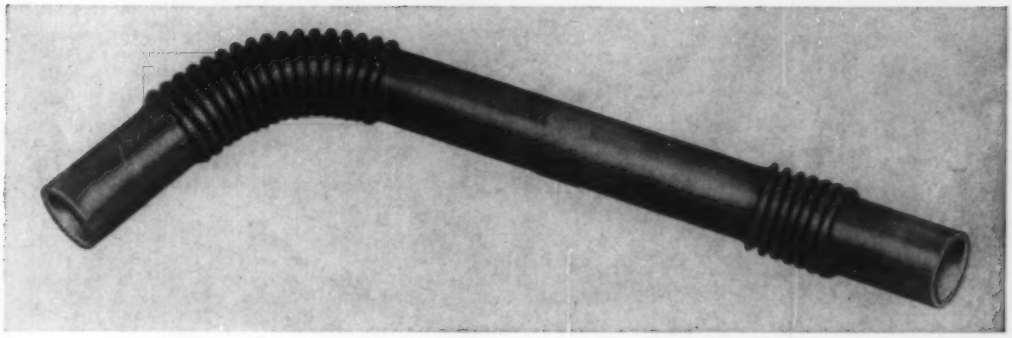


Coats Metal or Ceramic with Solid Plastic

Whirlclad coating process coats metal or ceramic parts with nylon, polyethylene, cellulosic, epoxy or polyether plastics. Preheated object is dipped into fluidized bed of finely divided dry coating powders.—*Polymer Corp., Booth 832.*

Circle 734 on Yellow Card

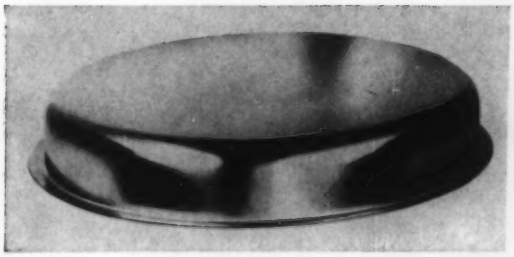




Resists Corrosion in Piping Systems

Molded Teflon bellows reinforced with wire can be used to absorb vibration, as an expansion joint, or to correct misalignment in piping systems. Fluoroflex-T bellows are highly resistant to corrosion and fatigue. —*Resistoflex Corp., Booth 331.*

Circle 735 on Yellow Card



Protects Prefinished Metals

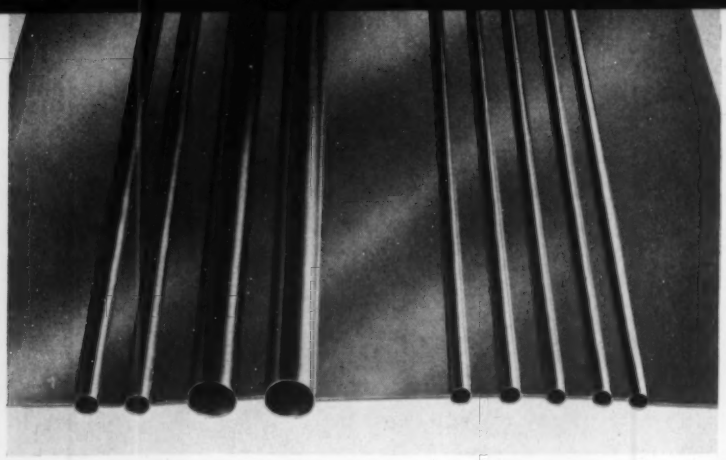
Clear baked synthetic finish protects copper and brass prefinished metals, can be stamped, drawn, roll-formed or seamed without peeling, cracking or flaking. Bake-Kote film on preplated copper shows 80 to 90 per cent better salt-spray resistance than ordinary lacquer.—*American Nickeloid Co., Booth 1307.*

Circle 736 on Yellow Card

Remains Clear Under Supersonic Heating

Safety glass windshields with new silicone-rubber interlayer remain clear in temperatures from −65 to 350 F. Made for supersonic aircraft, Silastic Type K interlayer does not soften, bubble or lose shear strength at high temperatures. —*Dow Corning Corp., Booth 406.*

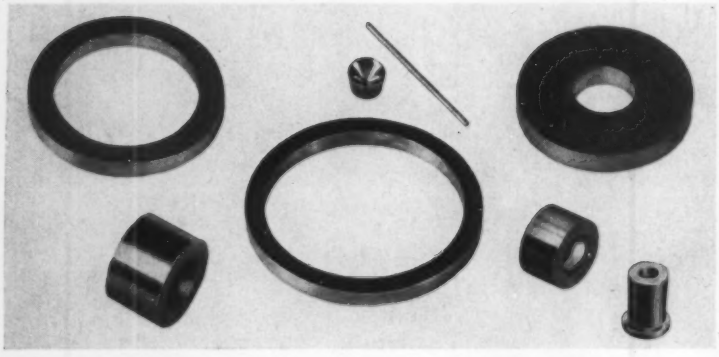
Circle 737 on Yellow Card



Inflates to Form Tubing

Tube-In-Strip sheet metal contains inflatable channels which can be expanded to variety of tube diameters, shapes and spacings. Available in solid sheets of copper, brass or aluminum.—*Revere Copper and Brass Inc., Booth 1635.*

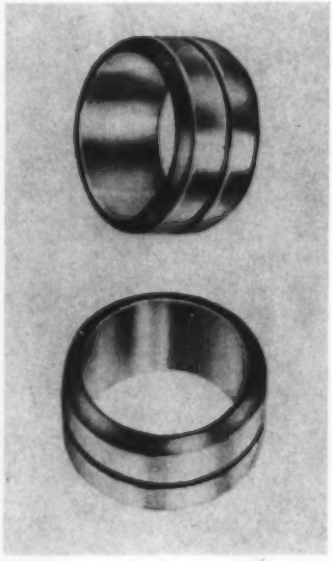
Circle 738 on Yellow Card



Bonds Carbide with Platinum

Platinum-bonded tungsten carbide is high-cost material with excellent corrosion resistance of platinum plus wear resistance of tungsten carbide. Less costly than platinum, volume for volume, K501 carbide is used for critical applications, such as rotary seals used in pumping fuming nitric acid. — *Kennametal Inc., Booth 923.*

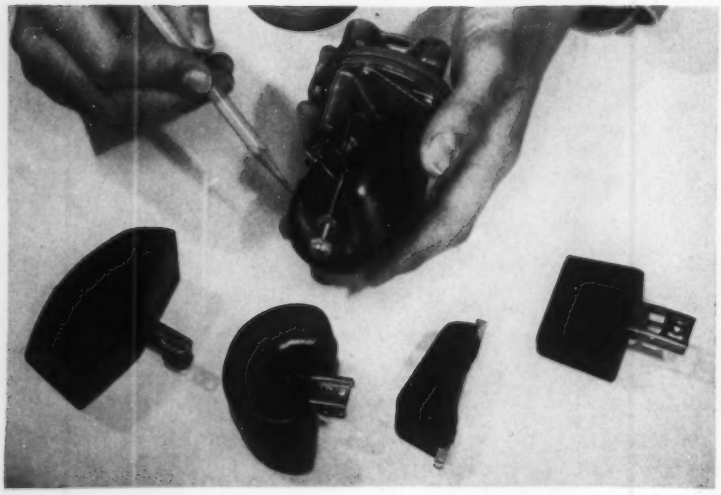
Circle 739 on Yellow Card



Surfaces Components with Hard Coatings

Flame-Plating coats metal parts with hard, wear-resistant tungsten carbide or aluminum oxide. Temperature of part during processing rarely exceeds 400 F. High resistance to chemical attack and high-temperature deterioration are features of hard aluminum-oxide coating.—*Linde Air Products Co., Booths 1005, 1009, 1013, 1019, 1023.*

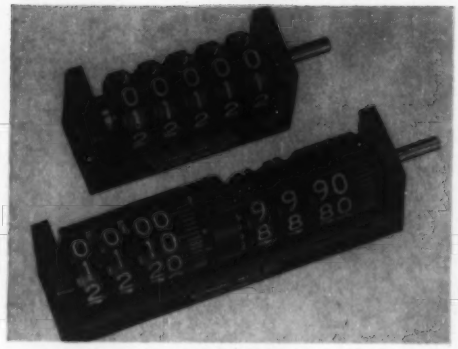
Circle 740 on Yellow Card



Makes Durable Rubber Floats

Custom-molded floats of sealed-cell-structure hard rubber are lighter than cork. Do not absorb fluid nor require protective coatings. Resist fungus growth, vibration, corrosion. Can be bonded around metal.—*Parker Appliance Co., Booth 1138.*

Circle 741 on Yellow Card



Count Fast; Small Size

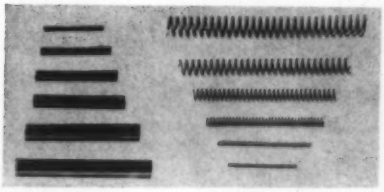
Small standardized Y-series counters run at speeds to 2500 rpm. Family of 96 models has identical case configurations, wheels and components. Used as readout indicators on controls, instruments, computers.—*Durant Mfg. Co., Booth 1141.*

Circle 743 on Yellow Card

Balances and Connects-in Resistance Bridges

Handles six resistance bridge circuits (six inputs). Accommodates two or four-arm external resistance bridges. Each channel is individually balanced; individual gain adjustment controls for each channel are used with deflection-type indicator instruments. Channel is selected by pushbutton. — *Ellis Associates, Booth 829.*

Circle 742 on Card



Available for Development Work

Stainless-steel springs available from stock in open and closed-wound types in five outside diameters and five wire sizes. Type 302 spring-temper stainless, clear passivated. — *PIC Design Corp., Booth 131.*

Circle 744 on Yellow Card

Has High Rigidity and Strength

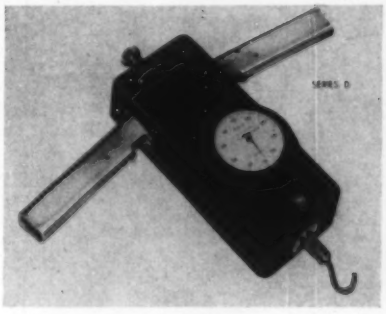
Custom-fabricated electronic chassis is made of magnesium for light weight, and designed for maximum rigidity and strength. —*Falstrom Co., Booth 1140.*

Circle 745 on Yellow Card

Measures Maximum or Variable Load

Force gages either hold maximum force, or follow all load fluctuations, depending on position of control button. Eighteen models, from 0-500 gm to 0-200 lb, measure tension or compression. — *Hunter Spring Co., Booth 1002.*

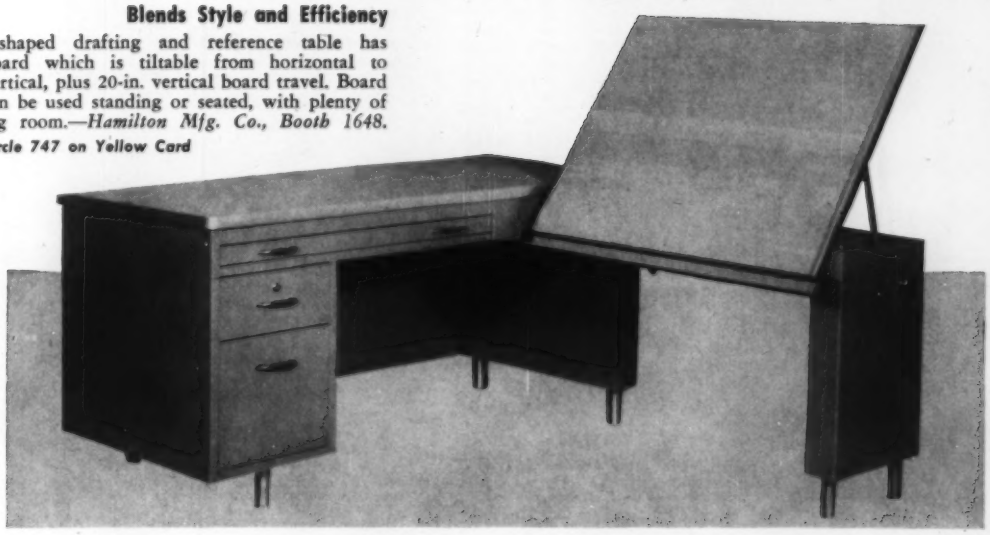
Circle 746 on Yellow Card



Blends Style and Efficiency

L-shaped drafting and reference table has board which is tiltable from horizontal to vertical, plus 20-in. vertical board travel. Board can be used standing or seated, with plenty of leg room.—*Hamilton Mfg. Co., Booth 1648.*

Circle 747 on Yellow Card



New ideas and methods for solving engineering problems . . .

Design Engineering Conference

THE three-day Conference held concurrently with the 1957 Design Engineering Show will have sessions devoted to new product design and the mechanical, materials and electrical aspects of design engineering.

The first day's program will be a question-and-answer panel session. Three concurrent sessions will be run on each of the next two days. All sessions will be in the morning, on the third floor of the New York Coliseum.

Registration for the sessions will be $5 for ASME members and $10 for nonmembers. A copy of the proceedings is included.

The Conference is sponsored by the Machine Design Div. of the American Society of Mechanical Engineers. A banquet sponsored by ASME will be held at 7 p.m. on Wednesday, May 22, at the North Ballroom, Hotel Sheraton-Astor. Principal speaker will be William F. Ryan, President, ASME. His topic will be "The Design of a Profession."

Monday, May 20—10 a.m.

PANEL DISCUSSION

Chairman and Moderator: George Nordenholt, Editor, *Product Engineering*. *Vice Chairman:* Charles Marks, Member, New York Bar and Patent Bar.

Procedures in Developing New Designs

T. M. Butler
Director of Engineering, Burroughs Corp.

Myron S. Curtis
Engineering Vice President, The Warner & Swasey Co.

George F. Habach
Vice President, Engineering, Worthington Corp.

Robert H. Hose
Partner, Henry Dreyfuss Associates

William J. Russell
Vice President, Engineering, Landers, Frary & Clark

Walter Dorwin Teague
Walter Dorwin Teague Associates

Tuesday, May 21—9:30 a.m.

MECHANICAL SESSION

Chairman: Colin Carmichael, Editor, MACHINE DESIGN. *Vice Chairman:* Robert M. Conklin, Assistant Manager, Mechanical Engineering Dept., Battelle Memorial Institute.

New Developments in Design and Application of Gearing

By Darle W. Dudley

Advanced Design Engineer, Gear Engineering, General Electric Co., West Lynn, Mass.

Progress and developments in gear design related to present-day and future requirements. Use of prime and derating factors will be discussed. Application of indexes, "K-factor," "unit load," and "Q-factor" are shown for estimating gear sizes. Examples of high-speed gearing, lightweight gears, and close-tolerance gears will be shown. Automation factors will be discussed.

New Developments in Design and Application of Cams

By Harold A. Rothbart

Professor, Department of Mechanical Engineering, City College of New York, New York.

Acceleration limits, choice of cam contour, required profile accuracy and manufacturing methods need be known in designing cams for high-speed mechanisms and industrial machinery. Comparisons between actual and theoretical acceleration curves will be shown. A dynamic design limit has been established as a guide in the development of new machines. Summary of both theoretical and practical considerations for high-speed cam follower performance.

MATERIALS SESSION

Chairman: Henry R. Clauser, Editor, *Materials and Methods*. *Vice-Chairman:* Joseph Bonanno, Chief Engineer, Lionel Corp.

Metallic Materials

By C. R. Simcoe

Principal Metallurgical Engineer, Battelle Memorial Institute, Columbus, O.

Major developments, including new metals and alloys for high-temperature use; new metals and alloys for use where strength-weight ratio is the most important factor; new combinations of metals such as honeycomb-sandwich construction; and new processes for improving the properties of metals and alloys. Materials include titanium, zirconium, molybdenum, alloys of aluminum and magnesium, and nodular ductile iron. Processes are vacuum melting and casting, chemical milling and others.

Ceramics and Refractory Materials

By John H. Koenig and Edward J. Smoke

Director and Professor, School of Ceramics, Rutgers University, New Brunswick, N. J.

A resume of recent technical developments in the field of ceramics. Refractories and refractory coatings; cermets; enamels; glass; dielectrics; porcelain and mechanical ceramics. Discussion of engineering and service properties, principal and potential areas of application.

ELECTRICAL SESSION

Chairman: Frank J. Oliver, Editor, *Electrical Manufacturing*. *Vice Chairman:* Walter T. Buhl, Vice-President, Engineering and Manufacturing, Leland Electric Co. Div., American Machine & Foundry Co.

Selecting Motors with New NEMA Frame Sizes

By Earl Barnes

Assistant Chief Engineer, Reliance Electric & Engineering Co., Cleveland

Significant changes in ac and dc motors. Application of these new motors to motor driven equipment can effect improvement in performance, economies in first cost and operation, improved appearance, reduction in size, and other benefits by using the new electrical and mechanical features.

Static Switching Devices

By Robert A. Mathias

Assistant Professor, Dept. of Electrical Engineering, Carnegie Institute of Technology, Pittsburgh

Basic logic functions of AND, OR and NOT will be described and related to relay switching circuits. Static logic power supplies, sensing and input devices, and output power amplifiers will be discussed and related to the relative cost factors of each. A description of the general procedure used for static switching systems will be given.

Wednesday, May 22—9:30 a.m.

MECHANICAL SESSION

Chairman: Harold Sizer, Director of Design for Machine Tools, Brown & Sharpe Mfg. Co. *Vice Chairman:* William C. Allen, Director, Manufacturing and Equipment Engineering, Westinghouse Electric Co.

Designing for Easier Machining, Handling and Assembly

By Kurt O. Tech

Vice-President in Charge of Engineering, Cross Co., Detroit

Design of a part can affect the product cost through the handling, storing and assembling of the part. Shapes of components affect material handling and storage. Locations of screws may make automatic simultaneous multiple assembly impossible. Parts designed for assembly are usually easy to store, handle, and machine. These problems should be considered early in any design project and carry equal weight when compared with the function and styling of a product.

Hopper Feeding

By Floyd E. Smith

President, Perry Equipment and Engineering Co., Erie, Pa.

Basic characteristics of various hopper feeds obtainable for installation on automatic machines. Proper type of feed determined by rate of feed, general toolability, area for installation. Advantages and disadvantages of each type will be given. General overall cost of hopper installations and amortization compared to direct labor cost.

MATERIALS SESSION

Chairman: Carl Massopust, Director of Research and Development, Plastics Div., General American Transportation Corp. *Vice-Chairman:* Donald R. Meserve, Products Manager, Organic Coatings, Metal and Thermit Corp.

Plastics and Rubbers

By Wyman Goss

Manager, Phenolics Engineering, Chemical Materials Dept., General Electric Co., Pittsfield, Mass.

Plastic materials are replacing older materials of construction in many fields. Ten different plastic materials or copolymers are being used in the automotive industry alone in electrical systems, fuel systems, transmissions, body, running gears, engines and accessories. Vinyls, styrenes, polystyrenes, phenolics are other resins which are being used to produce some 4 billion pounds of products. New applications for the older plastics, and new resins are being developed almost daily.

Coatings and Finishes

By H. J. Reindl

Supervisor, Research and Development, Finishes Section, Inland Mfg. Div., General Motors Corp., Detroit

Three general classes of coatings and finishing materials are to be discussed: organic coatings, metallic coatings and conversion coatings. Organic coatings include the varnishes and enamels. New coatings are the epoxy, Hypalon and polyurethane types. Metallic coatings are high-vacuum metallizing, electrically conductive coatings, tungsten carbide and others. Conversion coatings such as oxides on aluminum, phosphate and chromate are but a few of the types to be presented.

ELECTRICAL SESSION

Chairman: Dr. Cuthbert C. Hurd, Director of Automation Research, International Business Machines Co. *Vice Chairman:* John Randall, Assistant Director, Manufacturing Engineering Office, Ford Motor Co.

Numerical Control for Machinery

By Claud D. Coffin

Senior Electrical Engineer, Warner and Swasey Co., Cleveland

Factors that determine the economy of applying numerical controls to machines. Factors include: physical size of controls, complexity, maintenance, type of data, methods used, and the preparation of records. Also discussed are the types of machines for which numerical control is of doubtful value or even economically and technically unsound. Resume of the basic type of machinery controls which are the basis for determining whether or not numerical controls will be feasible.

Designing Machine Tools for Automatic Controls

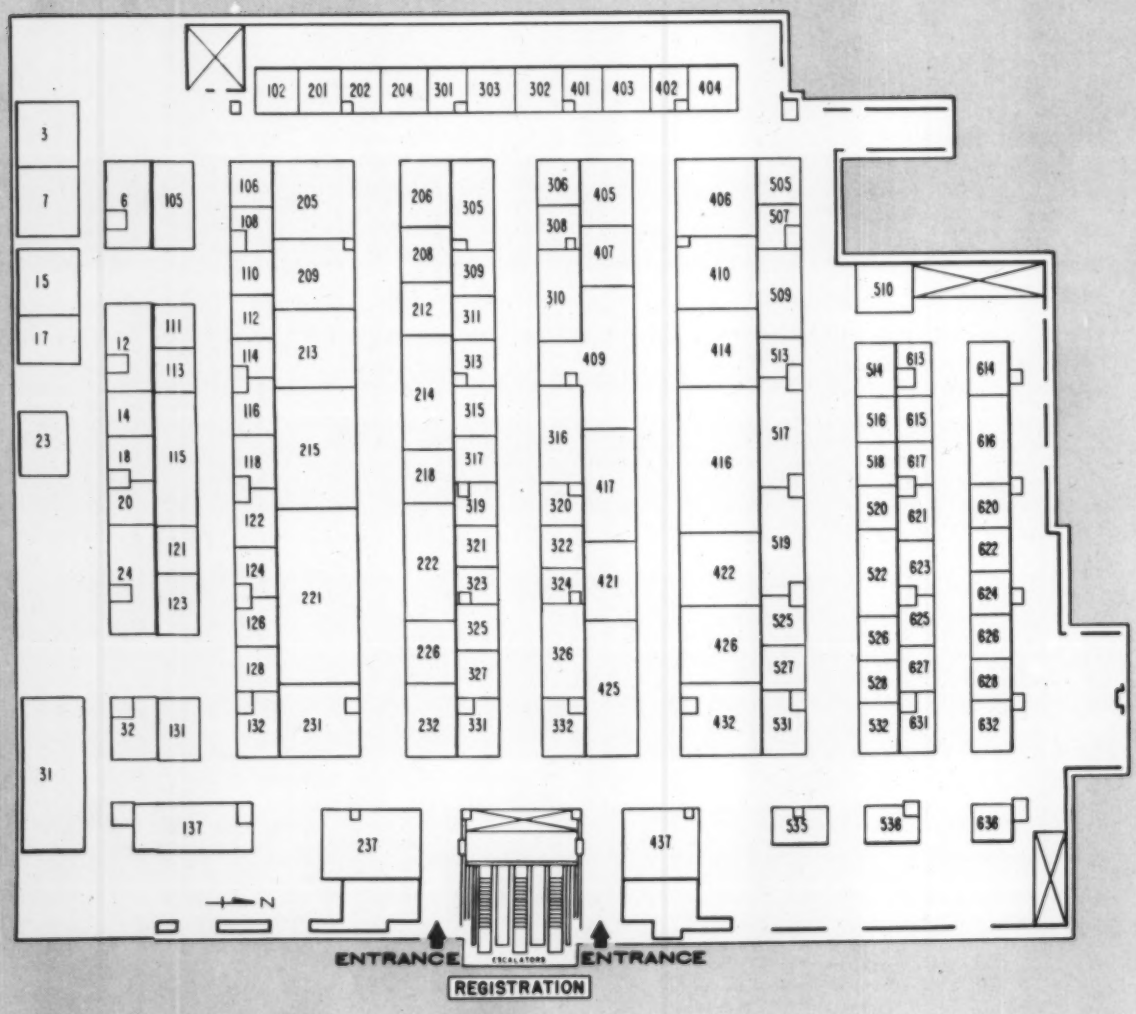
By C. B. Sung

Manager, Mechanical Development Section, Research Laboratories Div., Bendix Aviation Corp., Detroit

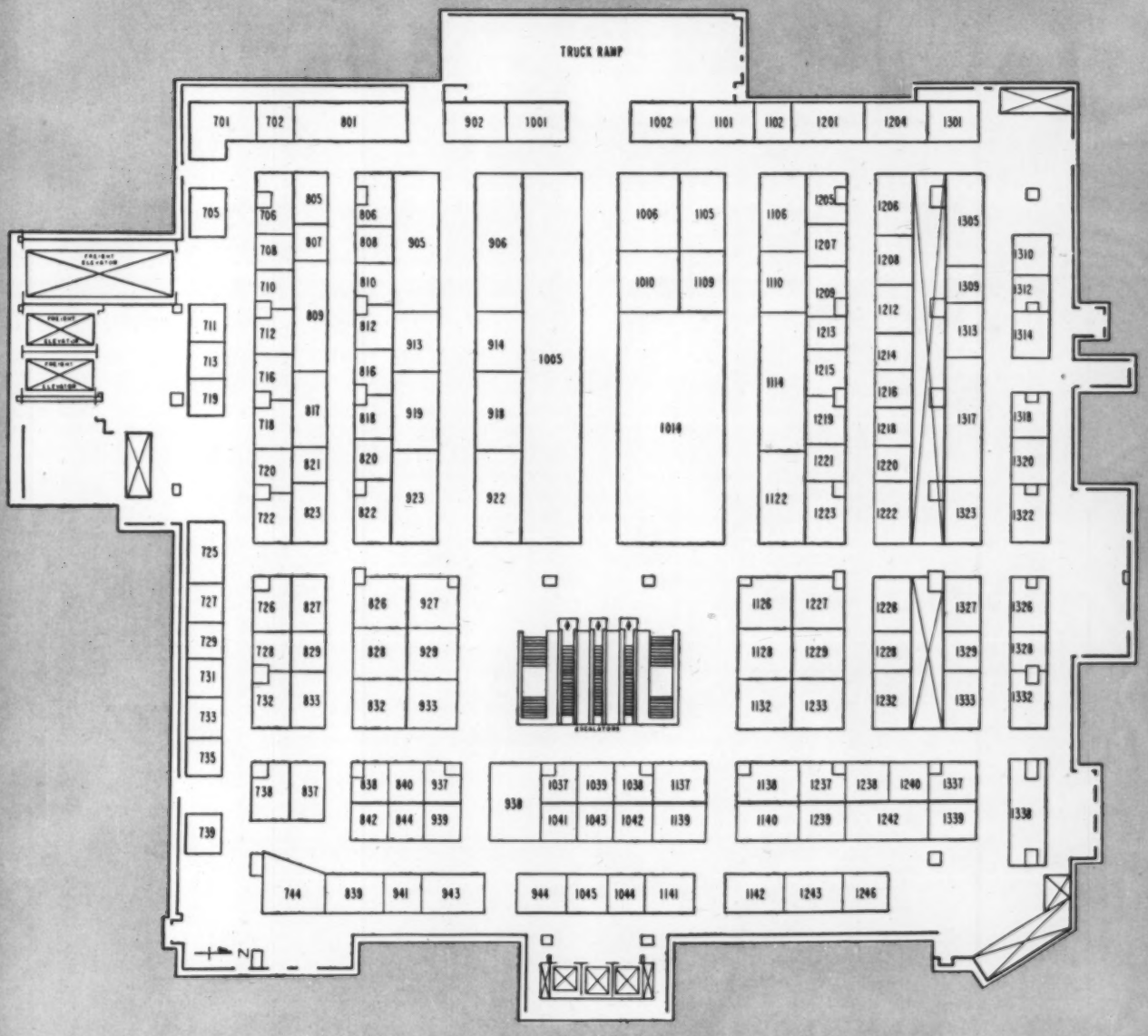
To achieve maximum economy, it is often desirable to design for high performance. Various considerations for adequate dynamic performance are discussed. Included are the nature of drive units, machine structure, friction, backlash, load disturbances and feedback instrumentation. Although considerations are for machine tools, most of them are applicable to other types of machines designed for automatic control.

Where to go . . . what to see . . . at the

Design Engineering Show



FIRST FLOOR

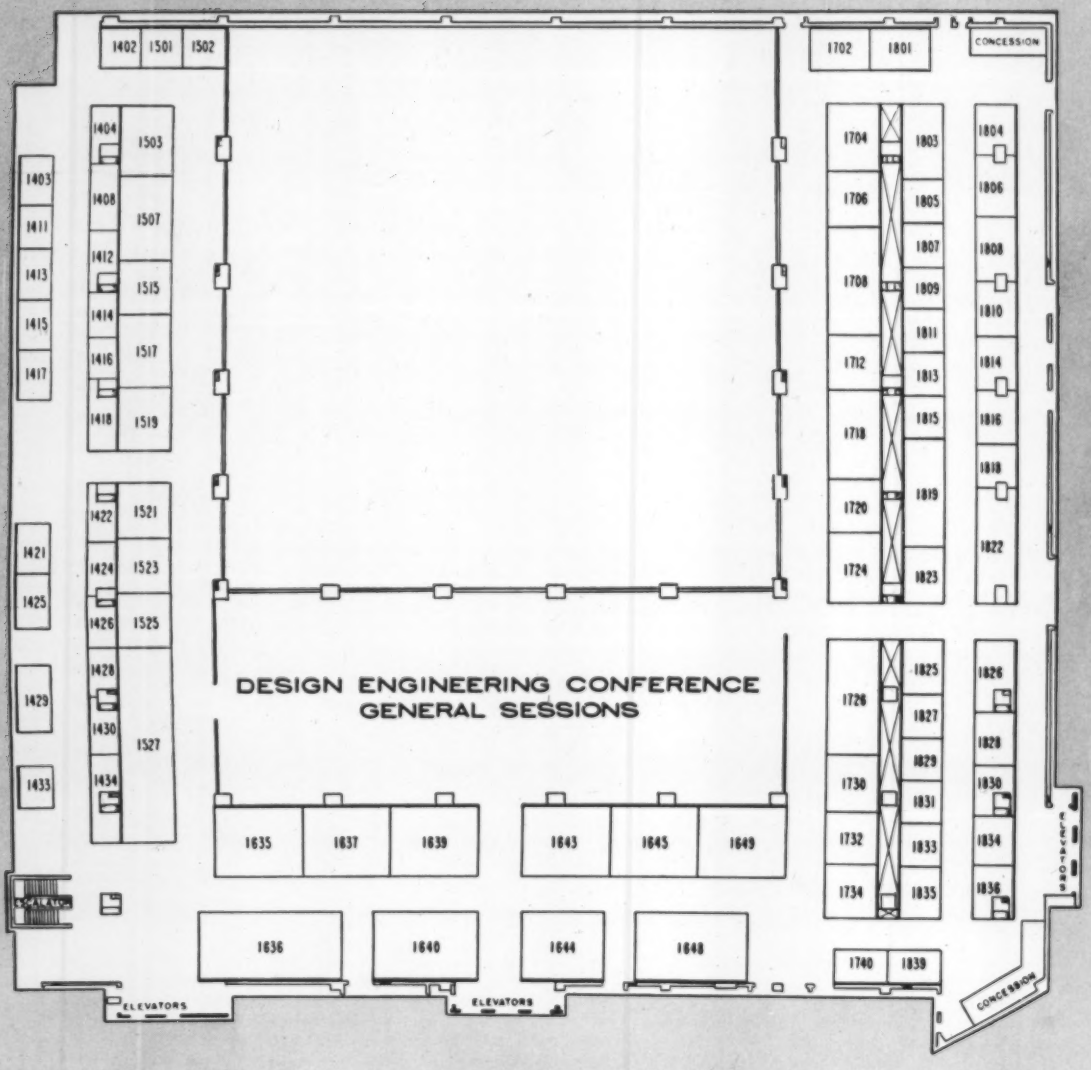


SECOND FLOOR

OVER 350 manufacturers will exhibit components and materials ranging from miniature fasteners to huge power drives at the Second Design Engineering Show.

The Show will be open from 12 noon to 6 p.m. on four days, May 20 to 23. Three floors of the New York Coliseum (Columbus Circle; Central Park South and Eighth Ave.) will house the exhibits. Expected attendance is over 20,000. Registration fee is $2, payable at the Show.

Exhibitor and Floor-Plan Guide: Manufacturers exhibiting at the Show and the products they will exhibit are listed on the following pages. Listed booth numbers are shown on the floor plans.



THIRD FLOOR

Manufacturers and Products

at the 1957 Design Engineering Show

Acme Steel Co. 1132
Wire stitchers for stitching metal to metal, or metal to other materials. 135th & Perry Ave., Chicago 27, Ill.

Actuator Products Corp. 20

Acushnet Process Co. 1408
Precision-molded parts of natural rubber, neoprene, Buna N, Hycar, fluorocarbons, silicones, silicone resin, GRS or Buna S, Hypalon, Kel F, Vyram, Adiprene; Apcotite bonded rubber to metal parts. Belleville Ave., New Bedford, Mass.

Aeroquip Corp. (See Marman Div.)

Agastat Div., Elastic Stop Nut Corp. of America 115

Aircraft-Marine Products Inc. 1834

Air-Maze Corp. 128

Alemite Div., Stewart-Warner Corp. 1232
Accumatic centralized lubrication systems; Oil-Mist lubrication systems; lubrication fittings. 1826 Diversey Pkwy., Chicago 14, Ill.

Al-Fin Div., Fairchild Engine and Airplane Corp. 801, 802, 804
Integral automobile wheel-brake drum of bonded bimetallic construction; airborne radar stable platform components; Naval torpedo depth control components; railroad diesel engine pistons; portable gasoline engine components; cookware. Deer Park, L. I., N. Y.

Allegheny Ludlum Steel Corp. 1212
Electrical steel laminations; steel extrusions; carbide products; stainless-steel expander rings; stainless-steel plates and coils; clad stainless steels. 2020 Oliver Bldg., Pittsburgh, Pa.

Allis-Chalmers Mfg. Co. 1730
Synductic. motor; specially designed 3500-rpm textile motor (type HAH); totally enclosed, nonventilated pancake-type motor for looms; air-cooled motor for spinning frame drive (type SG-1) designed for under-frame mounting; dc adjustable-voltage variable speed control system; Silco-Flex insulating system for form-wound motor and generator stator coils; one and two-groove Magi-Key sheaves for speed adjustment of Texrope V-belt drives in A and B sections; custom made rotary switches (type 210). P. O. Box 512, Milwaukee 1, Wis.

Louis Allis Co. 417, 419
Clean-Flo textile motors; Ajusto-Spede variable speed drive; weatherproof vertical pump motor; Syncro-Spede synchronous in-

duction motor; rapid reversing motor; Line-O-Motor gearmotor; open drip-proof motor; explosion-proof motor; right angle gearmotor. 427 E. Stewart St., Milwaukee 1, Wis.

Alloy Products Corp. 32

Aluminum Co. of America 1114, 1118

Aluminum Extrusions Inc. 844
Aluminum extrusions and components. Charlotte, Mich.

American Brass Co. 828
Duraflex superfine-grain phosphor bronze; Formbrite superfine-grain drawing brass; Electro-Sheet thin, electrolytically deposited sheet copper; Everdur copper-silicon alloys; brass die-pressed forgings; brass and bronze extruded shapes; duplex tubes; flexible metal hose assmblies in copper-base alloys, aluminum, stainless and carbon steels; Teflon flexible hose assemblies; multiple-plunger press products. 25 Broadway, N. Y. 4, N. Y.

American Chain & Cable Co. Inc. 1517

American Hardware Corp. (See Corbin Cabinet Lock Div.)

American Machine & Foundry Co. (See Leland Electric Co., Potter & Brumfield, Thompson-Bremer & Co.)

American Metal Hose Div. (See American Brass Co.)

American Nickeloid Co. 1307
Preplated copper, brass, nickel and chromium bright and satin-finished metals; crimped and striped-pattern preplated metals; BakeKote baked synthetic prefinished metals—on polished copper alloys and copper and brass-plated metals. 14 Second St., Peru, Ill.

American Plastics Corp. 111

American Society of Mechanical Engineers 726

Anchor Plastics Co. Inc. 319
Extruded plastic rods, tubes, shapes; fabricated extruded plastic components. 36-36 36th St., Long Island City, N. Y.

Anderson & Sons Inc. 1338, 1340, 1343
Nameplates; dials; auto emblems; rules; measuring gages; panels; escutcheons; plaques. N. Elm St., Westfield, Mass.

Anti-Corrosive Metal Products Co. Inc. 535

Applied Hydraulics Magazine 320

Armstrong Cork Co. 509, 511
Special adhesives and cements for custom application; production lin adhesives; friction materials for clutch plates; seamless rubber belts; feed rolls; vibration-damping asphalt-saturated felts; filter felts; latex-saturated felt papers used as base for plastic coatings and other specialized uses; Accopac asbestos gasket materials; fiber sheet materials; cork-and-rubber, rubber, and cork composition gasket materials. W. Liberty St., Lancaster, Pa.

Arrow-Hart & Hegeman Electric Co. 1831

Arwood Precision Casting Corp. 1243
Lost-wax investment castings in ferrous and nonferrous alloys, superalloys and tool steels. 321 W. 44th St., New York, N. Y.

Assembly Products Inc. 1323
Contact meter-relays; panel meters; LIAD analog-to-digital converter and multicontact meter-relay; VHS very high sensitivity nonindicating meter-relay; Simplytrol and Versatrol control packages thermistor-actuated Simplytrol; three-position controller with instantaneous action that corrects signal to specific point within preset range. Chesterland, O.

Associated Spring Corp. 205

Atkomatic Valve Co. Inc. 1807
Bronze and stainless steel two-way solenoid valves for pressures to 5000 psi. 545 W. Abbott St., Indianapolis, Ind.

Auburn Mfg. Co. 212
Plasti-Flex plastic shim and gasket stock; Alu-Flex conductive and shielding gasket material; gaskets, packings, washers, insulation components from all metallic and nonmetallic materials. Middletown, Conn.

Automatic Switch Co. 1204
Two, three and four-way solenoid valves—safety shut-off, pilot controlled, carbon dioxide, fuel shut-off, high pressure, vacuum types· electromagnetic controls—relays, contactors, remote-control switches, automatic transfer switches, battery charger, solenoids and complete panels. 50-56 Hanover Rd., Florham Park, N. J.

Automation 232

Automotive Industries 943

Aviation Developments Inc. 625

Bakelite Co. Div., Union Carbide & Carbon Corp. 1005, 1009, 1013, 1019, 1023
Epoxy phenolic, polyethylene, polyester, styrene and vinyl plastics. 30 E. 42nd St., New York 17, N. Y.

Barber-Colman Co. 1329
AC shaded pole motors (subfraction) hp unidirectional, reversable, synchronous types with or without reduction gearing); dc permanent-magnet motors (gearheads, centrifugal blowers, radio noise filters optional); 60-cycle chopper; ultra sensitive polarized dc relays (null-seeking, magnetic latching, shop-acting, and transistorized types). Rockford, Ill.

Bart Mfg. Corp. 218

Beaver Precision Products Inc. 324
Ball screws, aircraft and machine tool types; ball spline; transfer machine for shuttling engine blocks in automation line. 651 N. Rochester Rd., Clawson, Mich.

Beemer Engineering Co. 317
Oilite self-lubricating bearings, bars, plate stock, machine parts; strips and disks from ferrous and nonferrous materials; Parco O-Rings; Halogen machined and molded teflon parts; Aeroduct ducting; Tiarco hard surfacing. 401 N. Broad St., Phila. 8, Pa.

Bellows Co. 1643
Air motor—air cylinder with built-in valve and additional integral valves; Hydro-Check precision hydraulic control; Han-D-Air small air cylinder; Power Dome heavy-duty air cylinder; Bal-Air control valves; EPV air pilot valve; rotary feed and index tables. 230 W. Market St., Akron 3, O.

Benton Harbor Engineering Works 728

Beryllium Corp. 1203

Boston Gear Works 206
Speed reducers and variable-speed drives; spur, helical, miter, bevel and worm gears; chain and sprockets; bearings and pillow blocks; universal joints; couplings. 14 Hayward St., Quincy 71, Mass.

W. H. Brady Co. 1205

Brammer Corp. 1038
Detachable V-link belting in regular and special construction, including double vee, static conductive, and rawhide protector washer belting; Brammertools for assembly of detachable V-link belting. 654 Broadway, N. Y. 12, N. Y.

Brook Motor Corp. 23
3-hp-in-1 motor; increment-start motor for two-step starting; downdraft, drip-proof, all-weather motor; totally enclosed fan-cooled motors; drip-proof motors; flanged motors; extended-shaft motors. 3553-7 W. Peterson Ave., Chicago 45, Ill.

Charles Bruning Co. Inc. 1637
Copyflex Diazo reproduction machine and engineering reproduction machines; Visi-Vel tracing paper; optical tooling instruments; photo template or aluminum template processing materials; Mylar glass cloth drawing reproduction equipment; color films and film overlays. 4700 Montrose Ave., Chicago 41, Ill.

Budd Co. Inc. (See Continental-Diamond Fibre Corp.)

Buffalo Bolt Co. 134
Nylok self-locking, self-sealing fasteners; special fasteners. North Tonawanda, N. Y.

Burndy Engineering Co. Inc., Omaton Div. 1337
Uniring fully insulated, one-piece tap connector for shielded or coaxial cable; Unilok single wire or multiple gang disconnect panel; Stapin solderless receptacle tapered pin; Termatic machine for automatically installing wire to Fingrip quick-disconnect terminals at the rate of 6000 per hr; Bandolug machine for automatically installing wire to insulated lugs (Insulugs); Paneloks pressurized quick-disconnect panels for aircraft; Sealink insulated, watersealed splice for AN cable; electrical connectors and electronic components for OEM, aircraft and military; hand, hydraulic, pneumatic and automatic tooling. Norwalk, Conn.

Camloc Fastener Corp. 840
Quarter-turn fasteners; stressed panel fasteners; pushbutton latches; electronic fasteners; electronic chassis latches; access doors. 22 Spring Valley Rd., Paramus, N. J.

Casting Engineers Inc. 839

Celanese Corp. of America 515, 517
Fortisan rayson fiber; Arnel triacetate fiber; acetate fiber, filament and staple. 180 Madison Ave., N. Y. 16, N. Y.

Century Electric Co. 923
New NEMA size motors; fractional-hp motors; totally enclosed and hermetic motors; "short-frame" motor; four-motor Selective Speed drive. 1806 Pine St., St. Louis 3, Mo.

Cerro de Pasco Sales Corp. 1223
Fusible alloys: Cerrobase (255 F); Cerrobend (158 F); Cerrocast (281-338 F); Cerromatrix (218-440 F); Cerrosafe (160-190 F); Cerrotru (281 F); Cerroseal-35 (240 F). 300 Park Ave., N. Y. 22, N. Y.

Chain Belt Co. 1819, 1821

Champion Rivet Co. 1041
Upset forgings; welding electrodes. Harvard Ave. and E. 10th St., Cleveland 5, O.

Chicago -Allis Mfg. Corp. 518
Seal products—shaft and face type seal assemblies; leather products—leather packings with various impregnants; rubber products—synthetic rubber bellows, boots, diaphragms and precision rubber parts fabricated with or without cloth insertions. 113-125 N. Green St., Chicago 7, Ill.

Chicago Rawhide Mfg. Co. 616, 618

Chilton Co. 943

Cleveland Designers & Consultants Inc. 1045

Cleveland Graphite Bronze Co. 1329
Sleeve bearings; bushings; washers, seals, high temperature aircraft and accessories; wear plates for hydraulic pumps; self-aligning bearing. 17000 St. Clair Ave., Cleveland 10, O.

Cleveland Hardware & Forging Co. 1836

Cleveland Worm & Gear Co. 222, 234
Worm speed reducers; Speed Variator mechanical variable-speed drive. 3287 E. 80th St., Cleveland 4, O.

Coating Products Inc. 527
Mirro-Brite metallized and laminated Mylar material. 101 W. Forest Ave., Englewood, N. J.

Cobra Metal Hose Div., D. K. Mfg. Co. 309

Colonial Alloys Co. 1221
Mirodized sculptured metals, solid, perforated or expanded form, in all colors; patterned aluminum in coils, strip and sheet, tubing and wire. Ridge Ave. and Crawford St., Phila. 29, Pa.

Continental-Diamond Fibre Corp. 738
Vulcanized fiber; Dilecto laminated plastic; Vulcoid resin-impregnated vulcanized fiber; spiral tubing for coils and transformers; Celoron molded phenolic plastic; Micabond bonded mica splittings, tapes, sheets, fabricated parts; Teflon sheets, tapes and specialties. Newark, Del.

Controlex Corp. of America 1430
"Ball bearing" push-pull remote control. Westchester County Airport, P. O. Box 511, White Plains, N. Y.

Coors Porcelain Co. 403
Alumina ceramics, parts and components. 600 Ninth St., Golden, Colo.

Copper & Brass Research Association 1640

Corbin Cabinet Lock Div., American Hardware Corp. 1823
Cup and drop handles; Triplelox; two and three-point catches; spring-loaded heavy-duty pulldown catches; special locking devices; furniture locks; padlocks; cabinet closures; hose clamps. 102 Washington St., New Britain, Conn.

Crane Packing Co. 1042
Shaft seals for rotating shafts; mechanical packings; Lapmaster lapping machines; Chemlon products—sheet, rod, tape, tubing, bellows and custom molded or extruded parts of Teflon; thread sealing compounds for piping to 5000 psi and 500 F, and bolts or studs to 1200 F. 6400 Oakton St., Morton Grove, Ill.

Cross Engineering Co. 818

Cullman Wheel Co. 514
Roller chains; conveyor chains; stock sprockets; Grip-Master sprockets; flexible shaft couplings; machined products. 1344 W. Altgeld St., Chicago 14, Ill.

Cuno Engineering Corp. 1101
Auto-Klean and Super-Auto-Klean edge type filters; Micro-Klean disposable cartridge type filters; Poro-Klean porous stainless steel filter media. S. Vine St., Meriden, Conn.

Curtis-Wright Corp., Metals Processing Div. 1718

Curtiss-Wright Corp. (Also see Marquette Div.)

Cyclodynamics Inc. 1227
Cyclodyne drives and standardized power transmission components. 19025 W. Davison, Detroit 23, Mich.

Dayton Rubber Co. 519, 521
QVD fractional-horsepower V-Belt; Poly-Koolfoam synthetic foam; Metalastik rubber-to-metal antivibration devices; standard V-belts; Cog-Belt; variable-speed belt; double-angle belt; connector belt. Dayton 1, O.

Dearborn Glass Co. 1434
Glass dials; bent glass; tempered glass panels; Tru-Site non-reflecting glass; Nesa electrical conductive coatings; Glas-wich laminated glass decorated panels; ceramic coated glass, flat or bent. 6600 S. Harlem Ave., Argo, Ill.

Detroit Controls Corp. 823

Diamond Chain Co. Inc. 1720
Finished steel roller chain; stainless-steel and bronze chain; Taper Lock sprockets; finished bore sprockets; conveyor chains; flexible shaft couplings. 402 Kentucky Ave., Indianapolis 7, Ind.

Diehl Mfg. Co. 132

Dixon Automatic Tool Inc. 1826
Parts escapements and positioners; machine structure and control; intermittent drive. 2300 23rd Ave., Rockford, Ill.

Dixon Corp. 321
SB Rulon nonlubricated bearing material; bondable Teflon and Rulon; Rulon—a Teflon base product with high resistance and low cold flow; extruded, molded, hot-formed and machined Teflon products. Burnside St., Bristol, R. I.

Dixon Sintaloy Inc. 327

Dobeckmun Co. 426

Dochler-Jarvis Div., National Lead Co. 215
Die castings in zinc, aluminum, magnesium and copper-base alloys. Toledo 1, O.

Douglas Fir Plywood Association 410

Dow Chemical Co. 1503
Magnesium sheet and plate, tooling plate, extrusions, and sand, die and permanent-mold castings; high-temperature magnesium alloys for temperatures to 700-800 F. Midland, Mich.

Dow Corning Corp. 406
Silicone products; silicone molding compounds; fluorosilicone rubber; silicone rubber interlayer for safety glass windshields. Midland, Mich.

Dresser Mfg. Div., Dresser Industries Inc. 627
Pipe couplings and fittings; rings and weldments. Bradford, Pa.

Duff-Norton Co. 1704
Worm-gear jacks for lifting and lowering loads, application of pressure, and resisting impact. 2709 Preble Ave., Pittsburgh 30, Pa.

E. I. du Pont de Nemours & Co. 1014, 1018, 1022, 1113, 1119, 1123
Lucite acrylic plastic; Alathon polyethylene plastic; Teflon tetrafluoroethylene plastic; Zytel nylon plastic; Tynex nylon monofilament; Mylar polyester film; neoprene synthetic rubber; urethane foams based on Hylene organic isocyanates; titanium mill products, fabricated parts, and process equipment pieces. Wilmington 98, Del.

Durakool-Hermaseal Companies Inc. 1314

Durant Mfg. Co. 1141
Instrument counters for digital readout; base and panel-mounted electric counters; stroke counters; revolution counters; predetermined programming counters. 1933 N. Buffum St., Milwaukee 1, Wis.

Dynamic Gear Co. Inc. 939
Precision stock gears; custom-made gears and nylon gears; antibacklash assemblies; standard and miniature slip clutches; worms and mating helical gears; differentials; ratio and miter bevel gears; precision-ground shafting; shim spacers, collars and clamps. 20 Merrick Rd., Amityville, N. Y.

Dzus Fastener Co. Inc. 711

Eastman Chemical Products Inc. 221, 225
Tenite plastics. Kingsport, Tenn.

Eaton Mfg. Co., Reliance Div. 938, 940
Springtites and Sems; thread-cutting Springtites and Sems; Hoz-Pas-Ners; cold-drawn steel; spring lock washers; snap rings; terminal clamps; Keps. Massillon, O.

Ebert Electronics Inc. 1426
General-purpose mercury plunger relays; Micrelay, an electronic sensitive relay for control of high-power, high-current loads from low current, low power; MiniRelay single and double-pole miniature mercury-plunger relays; armored relay. 212-26 Jamaica Ave., Queens Village 28, N. Y.

Elastic Stop Nut Corp. of America 115, 117, 119
Stop nuts; Rollpins; self-locking inserts; time-delay relays. 2330 Vauxhall Rd., Union, N. J.

Electrical Coatings Inc. 202
Heat Sheets film-type electric heating elements. 11 Rantoul St., Beverly, Mass.

Electrical Manufacturers Service 1320, 1322

Electrical Manufacturing 929

Electro Dynamic Div., General Dynamics Corp. 712
Rerated dripproof ac motors; splashproof rerated ac motors; totally enclosed fan-cooled rerated frame ac motors; explosion-proof Class I, Group D, and Class II, Group E, F and G rerated ac motors; Selectron 5-hp adjustable speed drives; ac Gear-ED-Motors; large explosionproof motor, frame 505; large dripproof motor, frame 405. 163 Ave. "A", Bayonne, N. J.

Electro-Flex Heat Inc. 303

Electro Metallurgical Co. 1005, 1009, 1013, 1019, 1023
Titanium master alloys, including 40% vanadium-aluminum, 85% vanadium-aluminum, manganese-aluminum-titanium, aluminum-molybdenum, tantalum-columbium-aluminum, tin-aluminum-titanium, tungsten-aluminum-titanium, and aluminum-titanium; titanium metal sponge; chromium carbide; vanadium carbide; molybdenum disilicide; silicon nitride; vanadium metal. 30 E. 42nd St., N. Y. 17, N. Y.

Electro Snap Switch & Mfg. Co. 701
Precision snap-action switches; aircraft and industrial limit switches; hermetically sealed switches; basic subminiature and multipole switches; assemblies and actuators. 4218 W. Lake St., Chicago 24, Ill.

B. W. Elliott Mfg. Co. Inc. 719
Flexible shafting for power transmission. 350 State St., Binghamton, N. Y.

Ellis Associates 829
Strain gage instrumentation: BAM-1 bridge amplifier and meter for static and dynamic measurements; B-1 bridge, ac-powered, for static indicators, strip chart recorders, cathode-ray oscilloscopes; BSG-6 switch and balance unit for presetting up to six channels; BA-12 bridge amplifier for high-accuracy monitoring of fatigue tests; PM-1 peak meter; K-1 Results Now strain gage kit. Box 77, Pelham, N. Y.

Encyclopaedia Britannica 201

Engineered Nylon Products Inc. 1209

Eriez Mfg. Co. 315
Hi-Vi electro permanent magnetic vibratory feeders for feeding and controlling bulk materials; Magna-Mover magnetic elevator-conveyor for handling small parts up inclines. 1945 Grove Dr., Erie, Pa.

Fairchild Engine & Airplane Corp. (See Al-Fin Div., Stratos Div.)

Falstrom Co. 1140
Custom metal fabrication in steel, aluminum, and magnesium; electronic cabinets, cubicles, airborne chassis and consoles; radar and guided missile consoles; fabrications and weldments in magnesium and aluminum; instrument panelboards for power and processing plants; electronic relay racks and frames. Falstrom Ct., Passaic, N. J.

Farley & Loetscher Mfg. Co., Plastics Div. 18
Farlite industrial and decorative high-pressure laminated plastic. Dubuque, Iowa.

Farval Corp. 222, 224
Centralized lubricating equipment; circulating oil system; Lubrival progressive Dualine circulating oil system. 3287 E. 80th St., Cleveland 4, O.

Fasteners Inc. 516
Kelox inserts, studs, rings, turnbuckles. 580 Fifth Ave., N. Y. 36, N. Y.

Fastex Div., Illinois Tool Works 1310
Plasti-Grommets—nylon screw receptacles; Plasti-Rivets; Plasti-Supports—plastic shelf supports; Q Fasteners—quarter-turn fasteners; Speed Nuts; stamped gears; Plastinite strain-relief grommets; Plasti-Plugs—plastic one-piece snap-in hole plugs; Plasti-Rings; molding clips for decorative moldings; Springrip washers (shaft retainers). 195 Algonquin Rd., Des Plaines, Ill.

Faul & Timmins Inc. 1037
AsBesteel gaskets, metal-jacketed asbestos filled. 699 Seneca St., Buffalo 10, N. Y.

Federal-Mogul-Bower Bearings Inc. (See National Seal Div.)

Federal Tool & Mfg. Co. 1523
Short-run stampings. 8600 Alabama Ave., Minneapolis 16, Minn.

David Feldman & Associates 118
Microveer fine hardwood veneers (0.008-in. veneer laminated with clear overlay and thin aluminum backing). Calle Barranquitas 51, Santurce, Puerto Rico.

Fenwal Inc. 1414
Mechanical and electronic temperature-indicating controllers; midget and miniature thermostats; snap-action thermostats; differential-expansion Thermoswitch units; multipoint thermistor controller. Pleasant St., Ashland, Mass.

Ferguson Machine and Tool Co. Inc., Roller Gear Div. 306
Ferguson Drive cam indexing mechanism; Intermittor high-speed index table; rotary transfer machine for automatic assembly. P. O. Box 5841, St. Louis 21, Mo.

Firestone Tire & Rubber Co. 3, 7
Exon vinyl resins, Pottstown, Pa.

Flexible Tubing Corp. 316, 318

Flick-Reedy Corp. 1712
Tru-Seal fittings; air and hydraulic cylinders; accumulators and boosters. 2040 N. Hawthorne Ave., Melrose Park, Ill.

Fluidwick Co. Div., Tarn Corp. 536
Permawick lubrication; Permajector machine. 5319 E. Outer Dr., Detroit 34, Mich.

Foote Bros. Gear & Machine Corp. 725
Overhead conveyor reducer; Vari-Mount variable speed reducers; Maxi-Power parallel-shaft helical reducer; Hygrade worm and worm helical reducer; Gearmotor integral hp reducer; Line-O-Power helical speed reducer. 4545 S. Western Blvd., Chicago 9, Ill.

Formsprag Company 208
Clutches. 23601 Hoover Road, Van Dyke, Mich.

Foundry 232

Fox Co. 401
Embossed and enamelled nameplates; decorative metal parts; chrome trim; anodized aluminum parts. 3400 Beekman St., Cincinnati, O.

Frenchtown Porcelain Co. 311
Ceramics—alumina, alumina-mullite, zircon, steatite, zircon-mullite, cordierite, and feldspathic porcelain; Nicote metallized ceramic coating for soft solder application; Molcote metallized ceramic coating for hard solder applications; hermetic seals and metallized hermetic terminals; prototype ceramics; precision ground ceramics. Frenchtown, N. J.

Fromson Orban Co. Inc. 204
Lurium high-purity aluminum; Ano-Coil color-anodized aluminum strip in coils. 261 Madison Ave., N. Y., N. Y.

Garlock Packing Co. 1110
Mechanical packings; molded rubber packings; grease seals; mechanical seals; braided and molded packings; Kel-F, Teflon and silicone plastics; expansion joints; sheet packings. Palmyra, N. Y.

Gast Mfg. Corp. 1828
1/20 to 4 hp air motors; ½ to 45 cfm, 1/12 to 5 hp air compressors; dry vacuum pumps; rotary vane air pump. Box 117, Benton Harbor, Mich.

Gear Systems Inc. (See Geartronics Corp.)

Geartronics Corp. 20
Precision and commercial gears; complete gear systems. 50 Nashua St., Woburn, Mass.

General Analine & Film Corp. (See Ozalid Div.)

General Dynamics Corp. (See Electro Dynamic Div.; Stromberg-Carlson Co.)

General Electric Co., General-Purpose Control Dept. 422
Oiltight combination pushbutton and indicating-light contact unit; push-to-test indicating-light contact unit; pneumatic time-delay relay; static control elements; machine-tool relays; magnetic starters; limit switches; solenoids; general-purpose relays. Schenectady 5, N. Y.

General Electric Co., Industry Control Dept. 422
Vitreous enameled resistors; plate type field rheostats. P. O. Box 2488, Roanoke, Va.

General Electric Co., Metallurgical Products Dept. 1105
Cemented carbide wear parts; Hevimet; permanent magnets; thermistors; Thyrite varistors; vacuum-melted metals. Box 237, Roosevelt Park Annex, Detroit, Mich.

General Fireproofing Co. 1006
Draft-a-Matic drafting desk. Youngstown 1, Ohio.

General Motors Corp. (See Hyatt Bearings Div., New Departure Div., Saginaw Steering Gear Div.)

General Tire & Rubber Co. 213

Globe Co., Products Div. 1137
Gold Nugget welded grating; Grip-Strut safety grating; Globetray and Cable-Strut raceways or cable troughs. 4000 S. Princeton Ave., Chicago 9, Ill.

B. F. Goodrich Chemical Co. 913
Expanding sleeve joint for rigid vinyl pipe; 40-in. seal for butterfly valve; multiple honeycomb extrusion for railroad journal box; plastic survival gas mask for civil defense; one-piece plastic battery kit for service stations; rigid extrusions; foamed plastic sun visors; rigid vinyl separator plates for automotive batteries; electrical housings and panels made of nitrile rubber and phenolic blends; vinyl insulated conductors; vibration dampening pads of sisal and granulated cork integrated with a vinyl base. 3135 Euclid Ave., Cleveland 15, O.

Graham Transmissions Inc. 1326
Variable-speed transmissions; pneumatic and electrical transmission contorls. Menomonee Falls, Wis.

Gray Iron Founders' Society Inc. 1242, 1244

Gregory Industries Inc. (See Nelson Stud Welding Div.)

Gries Reproducer Corp. 421
Small zinc alloy die cast parts; small thermoplastic parts; nylon parts; Intercast movable element parts; insert cast and insert molded parts; special zinc alloy and plastic gears and pinions; special thermoplastic coil bobbins; stock fasteners, gears and pinions; insulators; knob bushings; ignition parts; tuning slugs; nylon rollers; hardware items. 125 Beechwood Ave., New Rochelle, N. Y.

Groov-Pin Corp. 532
Tap-Lok inserts; Groov-Pins. 1125 Hendricks Causeway, Ridgefield, N. J.

Grotnes Machine Works Inc. 405
Expanders for expansion-forming cylindrical, conical and polygonal parts; double-headed rim expander; coiler; combination Expander-Shrinker; shrinker; automatic pail line; weld rollers; seamer; rim rollers; body coiler; high-jaw expanders; offsetter; hydraulic shrinker; bead expander; weld trimmer. 5454 N. Wolcott Ave., Chicago 40, Ill.

Hamilton Mfg. Co. 1648
L drafting table; Auto-Shift table; filing units; engineering department accessories. Two Rivers, Wis.

Handy & Harman 1313

H. M. Harper Co. 1301

Hartford Machine Screw Co., Div. of Standard Screw Co. 116
Screw machine products; assemblies; Roosa-Master diesel fuel injection pump, textile spindles; hex cap nuts; socket fasteners; dowel pins; taper pins. Box 1440, Hartford, Conn.

Haynes Stellite Co. 1005, 1009, 1013, 1019, 1023
Vacuum melting facilities; investment-cast turbine wheels; compressor and turbine blades; industrial investment-cast parts; forgeable high-temperature alloys; wrought high-temperature alloys; corrosion-resistant alloys; hard-facing materials; metal ceramics; custom-finished parts from corrosion, heat, abrasion and erosion-resistant alloys; metal cutting tools. 725 S. Lindsay St., Kokomo, Ind.

Heim Co. 1233

Heintz Mfg. Co. 720

Heli-Coil Corp. 310, 312
Standard and Screw-Lock inserts; power inserting equipment. Danbury, Conn.

Heyman Mfg. Co. 937
Strain relief bushings for cords and cables. 100 Michigan Ave., Kenilworth, N. J.

Hilliard Corp. 1333
Over-running clutches and clutch couplings; single-revolution clutches; centrifugal clutch couplings; slip clutches and couplings; Wedge Roll over-running clutch; intermittent-motion drive unit. 100 W. 4th St., Elmira, N. Y.

Hitchiner Mfg. Co. Inc. 1333
Precision investment castings. P. O. Box 232, Milford, New Hampshire.

Hoke Inc. 1337
Forged brass, type 303 and 316 stainless steel, and Monel miniature needle valves; bar-stock brass, type 430 F and 316 stainless steel, and carbon-steel needle valves; brass, stainless steel and Monel packless valves; variable area type flow gages; pressure regulators; sampling cylinders; metering valves. 136 S. Dean St., Englewood, N. J.

Homestead Valve & Mfg. Co. 1421

Hoover Ball and Bearing Co. 1734
Ball bearings; balls. Ann Arbor, Mich.

Hoover Co., Casting Div. 1811

E. F. Houghton & Co. 226
Hydraulic and pneumatic packings—homogeneous rubber, fabricated rubber, wax-impregnated leather, rubber-impregnated leather cups, U, V, O-rings, and flanges; hydraulic oils and fluids—Hydrodrive fortified petroleum oil Hydrolube for water hydraulic systems, Houghto-Safe fire-resistant hydraulic fluid. 303 W. Lehigh Ave., Philadelphia 33, Pa.

Howard Foundry Co. 906, 910
Sheathed-tube coring method for molding small-diameter, intricately shaped, unlined passageways in aluminum and magnesium-alloy sand-cast parts; stainless, carbon and alloy steel sand mold and investment castings; high-temperature magnesium-alloy sand castings for aircraft parts; shell-mold ferrous and nonferrous alloy castings; sand and permanent-mold aluminum alloy castings; titanium development casting work. 1700 N. Kostner Ave., Chicago 39, Ill.

Huck Mfg. Co. 919
Conical Keystone Lock blind rivets; Huckbolt self-plugging blind rivets; Daisy blind rivets; Tau Bolt flush blind fasteners; hydraulic and pneumatic driving tools, and portable hydraulic power cells for hydraulic driving tools. 2480 Bellevue Ave., Detroit 7, Mich.

Hunter Spring Co. 1002
Neg'ator constant-force extension spring; Neg'ator constant torque, long-running spring motor; Spir'ator retriever reel; Hunter mechanical force gages; Hunter Hold-Maximum mechanical force gages; Flex'ator constant-force compression spring; precision wire springs—compression, extension, torsion. 1 Spring Ave., Lansdale, Pa.

Hyatt Bearings Div., General Motors Corp. 1639
Roller bearings. Harrison, N. J.

Illinois Tool Works (See Fastex Div., Licon Div., Shakeproof Div., Spiroid Div.)

Imperial Brass Mfg. Co. 944
Hi-Seal fittings in steel; Poly-Flo fittings for polyethylene tubing; Nylo-Seal nylon fittings for metal or plastic tubing; Hi-Duty brass and aluminum fittings for speedy assembly; Flex Fittings for vibration; 37-deg flare fittings in brass, steel and stainless steel; Ermeto fittings; 45-deg flare, compression, and standard fittings; fluid control valves; Hi-Duty shutoff valves; blow-down valve; pressure hose and reusable couplings; tube cutters; flaring tools; double flaring tools; tube benders; swaging tools; test plugs for tubing lines; refacing tools. 1200 W. Harrison St., Chicago 7, Ill.

Improved Seamless Wire Co. 739

Indiana Steel Products Co. 622
Cast and sintered Alnico permanent magnets; Indox ceramic permanent magnets; Cunife and Cunico ductile permanent magnets; sintered Indalloy magnets; formed chrome and cobalt steel magnets. Valparaiso, Ind.

Industrial Equipment News 1220

Instrument Specialties Co. Inc. 632
Beryllium-copper helical springs, strip-springs and screw-machine products. Little Falls, New Jersey.

International Packings Corp. 1126

Iron Age 943

Jones & Laughlin Steel Corp. 237
Hot-extruded cold-drawn bars. 3 Gateway Center, Pittsburgh 30, Pa.

Kaydon Engineering Corp. 1724
Special flanged bearings; four-point contact bearings; two-row bearings with flanges and mounting holes; needle rollers; needle bearings; taper bearings (thin section); radial roller bearings; Reali Slim bearings. Muskegon, Mich.

Kennametal Inc. 923
Kentanium heat-resistant titanium carbide; platinum-bonded tungsten carbide; metallurgical products; wear resistant parts; metal cutting tools. Latrobe, Pa.

Keuffel & Esser Co. 1507, 1513
Stabilene film for making reproductions directly from originals drawn or scribed on film; Micro-Master 105 Process—a 105-mm film system for reproducing drawings to 36 x 54 in.; Paragon drafting machines; Leroy lettering and symbol drawing equipment; slide rules. Adams and Third Sts., Hoboken, N. J.

L & L Mfg. Co. 231
Hydraulic straight-thread metallic boss and O-ring boss seal fittings; JIC steel tube fittings; Dryseal pipe fittings; flange fittings; needle valves; Dryseal pipe nipples. 8088 E. Nine Mile Rd., Van Dyke, Mich.

Laminated Shim Co. 812
Laminum laminated shims in stainless steel (0.002 and 0.003-in.), aluminum (0.003-in.), brass (0.002 and 0.003-in.), and mild steel (0.002 and 0.003-in.). 220 E. 42nd St., N. Y. 17, N. Y.

Lamson Corp. 722
Blowers. Syracuse 1, N. Y.

Lamson & Sessions Co. 1216
Plug nuts; Stover Automation locknuts. 1971 W. 85th St., Cleveland 2. O.

Lancaster Lens Co. 624

Landis & Gyr Inc. 1328
Sodeco electrical impulse and preselection counters with manual or electrical reset, high-speed impulse counter and impulse transmitter, adding and subtracting counter, plug-in type impulse counter, and pulse-operated decades; RMB miniature radial ball and roller bearings, pivot bearings and special bearings. 45 W. 45th St., New York 36, N. Y.

La Salle Steel Co. 905, 909
"e.t.d." (elevated temperature drawing) process of drawing steel bars at preselected temperatures to obtain uniformity and control of properties; Fatigue-Proof steel. P. O. Box 6800-A, Chicago 80, Illinois.

Leach & Garner Co. 526
Sheet wire and tubing in precious metals; laminated precious metals to nonferrous bases; silver solders and brazing alloys; precision rolling and drawing. Attleboro, Mass.

Lehigh Chemical Co. 305, 307
Anderol L-285 wide temperature range lubricant; synthetic lubricants. Chestertown, Md.

Leiman Bros. Inc. 1219
Air-cooled high vacuum pump; integral vacuum and pressure pumps. 146-181 Christie St., Newark 5 N. J.

Leland Electric Co., Div. of American Machine & Foundry Co. 1313
Polyphase, open drip-proof, integral-hp motors to NEMA reframe dimensions; single-phase, capacitor-start induction-run motors; standard gasoline pump motor; 215 reframe polyphase, explosion-proof, externally ventilated motor; submersible explosionproof motor, Micro-Power standby or emergency power motor-alternator-gasoline engine set; fractional-horsepower brake motor; specially engineered motors. Dayton 1, O.

Licon Div., Illinois Tool Works 1822, 1824
Electrical switches. 2501 N. Keeler Ave., Chicago 39, Ill.

Lignum-Vitae Products Corp. 1206

Linde Air Products Co. 1005, 1009, 1013, 1019, 1023
Industrial crystals—single-crystal sapphire windows, and single-crystal sapphire rods, boules, special shapes; Flame Plated coatings—tungsten carbide and aluminum oxide. 30 E. 42nd St., N. Y. 17, N. Y.

Linemaster Switch Corp. 407
Foot switches. Woodstock, Conn.

Link-Belt Co. 31
Power transmission and conveying equipment; P.I.V. variable speed drives; Motogear; self-aligning bearings; ball and roller bearings; babbitted bearings and takeups; roller, silent and other chains; geared flexible couplings. Prudential Plaza, Chicago,, Ill.

L. O. F. Glass Fibers Co. 817, 819

Lovejoy Flexible Coupling Co. 113
Flexible couplings; variable-speed pulleys for adjustable bases; Select-o-speed transmissions up to 10-1 speed ratio; aircraft type universal joints; variable-speed belts and sheaves; Auto tension motor bases. 4949 W. Lake St., Chicago 44, Ill.

Machine Design 232

Machinery Magazine 631

Mac-It Screw Div., Strong, Carlisle & Hammond 1413
Socket-head cap screws; other alloy-steel screws. 1392 W. 3rd St., Cleveland 13, O.

MacLean-Fogg Lock Nut Co. 821
Two-Way locknuts; Uni-Torque locknuts; locknuts No. 1; Speed Holding locknuts No. 2; Stin-Lock nuts; weld nuts; weld nuts with lock. 5535 N. Wolcott Ave., Chicago 40, Ill.

Magnaflux Corp. 827
Stresscoat brittle lacquer coating for experimental stress analysis. 7300 W. Lawrence Ave., Chicago 31, Ill.

Malayan Tin Bureau 1835

Mallory-Sharon Titanium Corp. 805
Titanium wrought mill products. Niles, O.

Manheim Mfg. & Belting Co. 615

Marco Industries Inc. 1433
Fractional-horsepower motors; permanent split-capacitor motors; shaded-pole motors; motors for air moving devices. 3rd and Franklin Sts., Womelsdorf, Pa.

Marman Div., Aeroquip Corp. 727, 729
Universal Jr. clamp; Flex Master pipe coupling; Venti-Duct pneumatic coupling system; Service Master low-pressure V-band tube coupling system; Hi-Strength sanitary toggle hose clamp and sanitary hose clamp. 11214 Exposition Blvd., West Los Angeles, Calif.

Marquette Div., Curtiss-Wright Corp. 918
Standard Precisionspring clutches for over-running, indexing and backstopping; special design spring clutches. 1145 Galewood Dr., Cleveland 10, O.

Masland Duraleather Co. 1238
Masland Duran Clad vinyl to metal laminates; Masland Duran Rigid vinyl for vacuum forming. Amber & Willard Sts., Phila. 34, Pa.

Massachusetts Gear & Tool Co. (See Geartronics Corp.)

Materials & Methods 425, 431

Maurey Mfg. Corp. 731
Fractional-hp V-pulleys and V-belts; multiple-duty sheaves and Multi-duty V-belts; V-drive accessories, collars, bushings, etc.; Maureymatic variable speed transmission. 2907-23 S. Wabash Ave., Chicago 16, Ill.

Mechanical Industries Production Co. 902

Mechanical Products Inc. 702
Circuit breakers; Mini-Breaker house-circuit breakers; miniature aircraft circuit breakers. 1824 River St., Jackson, Mich.

Meehanite Metal Corp. 105, 107
Meehanite engineered castings; centrifugal Meehanite castings; heat-resistant castings; corrosion-resistant castings; wear-resistant castings. 714 North Ave., New Rochelle, N. Y.

Merkle-Korff Gear Co. 1317
Fractional-horsepower gear reducer motors. 213 N. Morgan St., Chicago 7, Ill.

Metal Powder Association 1649

Micro Switch Div., Minneapolis-Honeywell Regulator Co. 744
Miniature snap-action switches; aircraft emergency escape light; magnetically held lighted pushbutton switch; alternate-action lighted pushbutton switch. Freeport, Ill.

Miller Fluid Power Corp. (See Flick-Reedy Corp.)

Minneapolis-Honeywell Regulator Co. (See Micro Switch Div.)

Minnesota Mining & Mfg. Co. 1108
Contact bond adhesives and epoxy resin adhesives for sandwich panel construction; Scotch-Weld thermosetting dry bonding film adhesives for sandwich panel construction and high-strength structural bonding; Scotch-Foam thermosetting, self-curing polyisocyanate foams; epoxy resin adhesives for high-strength structural bonding; specialized extruded sealers; Weatherban rubber-base sealers for curtain-wall panels; adhesives, coatings and sealers for general-purpose use. 411 Piquette Ave., Detroit 2, Mich.

Modern Design 914

Molded Fiberglass Co. 1429

Morse Chain Co. 1708, 1710
Morflex flexible couplings; chain couplings; torque limiters; overrunning clutches; Pullmore clutches; speed reducers; roller chain; silent chain; Hy-Vo chain; mechanical power transmission products. Ithaca, N. Y.

J. Frank Motson Co. 716

Multiple Extrusions Inc. 1428

James A. Murphy Inc. 1809

Mycalex Corp. of America 102
Supramica ceramoplastics; Mycalex glass-bonded mica; Mycalex TM commutation switches; Synthamica synthetic mica. 125 Clifton Blvd., Clifton, N. J.

National Lead Co. (See Doehler-Jarvis Div.)

National Lock Co. 733
Cabinet hardware; butts and hinges; furniture trim; screws and bolts; range hardware; locks; die-cast products; refrigerator hardware; plastic products; casters. 1902 Seventh St., Rockford, Ill.

National Seal Div., Federal-Mogul-Bower Bearings Inc. 1417
Syntech synthetic rubber oil seals; Micro-Torc leather oil seals; O-rings; laminated shims. Redwood City, Calif.

National Starch Products Inc. 126
Granite Board particle board. 270 Madison Ave., N. Y. 16, N. Y.

National Vulcanized Fibre Co. 837
Phenolite laminated plastic; National nylon; extruded nylon rod; vulcanized fiber; Phenoclad cold-punching copper-clad laminate. Wilmington 99, Del.

Nelson Stud Welding Div., Gregory Industries Inc. 326, 328
End-weld studs; CP stud; large diameter studs (¾ to 1 in.). Toledo Ave. & E. 28th St., Lorain, O.

New Departure Div., General Motors Corp. 1240
Pillow blocks; precision ball bearings; Sentri-Seal and lubricated-for-life ball bearings. Bristol, Conn.

New Equipment Digest 232

New Hermes Engraving Machine Corp. 106

Newark Wire Cloth Co. 628

New York Belting & Packing Co. 1237
Gilmer Timing Belt drives. 1 Market St., Passaic, N. J.

Nice Ball Bearing Co. 206
Single-row ground and unground radial bearings with solid, two-piece or flange outer races; combination unground radial and thrust bearings; ground and unground thrust bearings; clutch-release bearings; pressed-steel trolley wheels, sheaves, and

wheels; hangar and flange-mounted bearings; thrust ball retainers. 30th and Hunting Park Ave., Philadelphia 40, Pa.

North Shore Nameplate Inc. 846
Speedy-Cal (for smooth surfaces) and Therma-Cal (rough surfaces) aluminum foil anodized, etched, pressure-sensitive nameplates, dials, instruction plates, schematics, etc.; Cal-Matic automatic dispenser; Speedy-Marx printed adhesive tape markers and printed aluminum adhesive markers for wire, cable, pipe. 214-27 Northern Blvd., Bayside 61, N. Y.

Nylok Corp. 1102
One-piece self-locking screws, nuts, bolts, set screws, clinch nuts, cap nuts, and threaded inserts. Industrial Ave., Paramus, N. J.

Ohio Gear Co. 621
Ohio speed reducers; stock gears; special gears. 1333 East 179th St., Cleveland 10, O.

Oilgear Co. 1740
Any-Speed electrohydraulic servo-controlled drive; electrohydraulic servo components. 1560 W. Pierce St., Milwaukee 4, Wis.

Omaton Div. (See Burndy Engineering Co. Inc.)

Orange Roller Bearing Co., Inc. 531
Roller bearings, including needle, staggered, journal and thrust bearings, cam followers and special designs. 557 Main St., Orange, N. J.

O'Sullivan Rubber Co. 313
Sulivyne-Clad, plastic sheeting bonded to flat sheets of aluminum, steel and magnesium; Sulivac rigid and semirigid thermoplastic modified styrene copolymer sheeting for vacuum molding. Valley Pike, Winchester, Va.

Owens-Corning Fiberglas Corp. 1142
Glass-reinforced thermoplastic; phenolic glass-filled molding compound; premix of glass with other fiber; Fiberglas electrical insulations; molded Fiberglas wool; Fiberglas hand lay-ups; preformed reinforced plastic items; built-up roofing; woven Fiberglas-vinyl fabric. National Bank Bldg., Toledo 1, O.

Ozalid Div., General Aniline and Film Corp. 404
Printmaster and Streamliner whiteprint machines; blue and blackline sensitized papers; Mylar, glass-cloth, sepia line paper, litho-foil, and double-coated intermediate materials. Johnson City, N. Y.

Paragon Revolute Corp. 24

Parker Appliance Co. 1138
Triple-lok flare type and Ferulok flareless type tube fittings; tube-working tools; Hoze-lok fittings for hydraulic hose; synthetic rubber O-rings; custom-molded rubber parts; unicellular rubber floats; thread sealing compounds. 17325 Euclid Ave., Cleveland 12, O.

Penton Publishing Co. 232

Perkins Machine & Gear Co. 14

Pheoll Mfg. Co. 623
Tapping screws; thread-cutting screws; Phillips recessed screws; slotted screws; machine screws, cap screws; set screws; special cold-headed products; special screws; lag screws; machine bolts; special assemblies; Tuff-Tite screws; special bolts; threaded rods; special rivets and pin. 5700 W. Roosevelt Rd., Chicago 50, Ill.

PIC Design Corp. 131
Precision gears, metallic and nonmetallic; shafts; couplings; ball bearings; hubs; clamps; cleats; miter and bevel gears; shaft hangers; breadboard kits; dial and vernier sets; speed reducer kits. 477 Atlantic Ave., E. Rockaway, N. Y.

Polymer Corp. 832
Polypenco nylon, Teflon, cross-linked polystyrene, and chlorinated polyether plastic shapes; Nylaflow polyamide plastic tubing; Whirlsint plastic powders for coating parts by Whirlclad process; Nylatron plastic molding powders, Nylasint finely divided nylon powders for sintering. 2120 Fairmount Ave., Reading, Pa.

H. K. Porter Co. Inc. (See Riverside Alloy Metal Div.)

Potter & Brumfield Inc. Div., American Machine & Foundry Co. 121
Relays. Princeton, Ind.

Precision Metal Molding Magazine 320

Presco 617

Process Gear Co. 810
Fine-pitch nylon molded and cut gears; metal and Bakelite gears. 4616 Fullerton Ave., Chicago 39, Ill.

Product Engineering 1122

Pyle-National Co. 614
Electrical connectors, plugs and receptacles; conduit fittings; lighting equipment; ¼ to 120 hp mechanical drive steam turbines. 1334 North Kostner Ave., Chicago 51, Ill.

Raybestos-Manhattan Inc. 1519
Mechanical packings and gasket materials; friction materials; plastic products; asbestos products for reinforced plastics; power transmission equipment; Poly-V drives. Passaic, N. J.; Manheim, Pa.; Bridgeport, Conn.

Reinhold Publishing Corp., Book Div. 425, 431

Reliance Div. (See Eaton Mfg. Co.)

Reliance Electric and Engineering Co. 214, 216
V-S Jr. all-electronic variable-speed drive; right-angle gearmotor; Vari-Speed Motodrive; totally-protected ac motors; Reeves motor pulley; Reeves variable-speed transmission. 24701 Euclid Ave., Cleveland 17, O.

Remington Rand Div., Sperry Rand Corp. 308
Film-A-Record planetary cameras for microfilming engineering drawings. 315 Fourth Ave., New York 10, N. Y.

Republic Steel Corp. 1726, 1728
Enduro stainless steel; iron powder; tubular products; titanium; Nylok bolts and nuts; plastic pipe, flexible and semirigid; X-Tru Coat plastic-coated steel pipe; Electro Paintlok sheets. Republic Bldg., Cleveland 1, O.

Resistoflex Corp. 331
Fluoroflex-T (Teflon) hose for corrosion resistance and high temperature application; Compar hose for hydrocarbon solvents; Fluoroflex-T (Teflon) laminated pipe, bellows molded of special Teflon compound, and stress-free nonporous rods, sheets and tubing; Fluoroflex-C (Kel-F) sheets, rods, tubes and electrical sleeving. Woodland Rd., Roseland, N. J.

Revco Inc. 1825

Revere Copper and Brass Inc. 1635
Aluminum, brass and copper mill products; Tube-in-Strip sheet metal containing inflatable channels, printed-circuit copper. 230 Park Ave., N. Y. 17, N. Y.

Reynolds Metals Co. 314, 409, 413, 415

M. H. Rhodes Inc. 636
Mark-Time mechanical timing devices; time-delay relays; standard timers; timing switches. 30 Bartholomew Ave., Hartford, Conn

Rigidized Metals Corp. 927
Rigid-Tex metal patterns and fabricated parts. 658 Ohio St., Buffalo 3, N. Y.

Riverside-Alloy Metal Div., H. K. Porter Co. Inc. 1246
Wire, rod and strip in nickel and nickel alloys, stainless steels; phosphor bronze, nickel silver, beryllium copper, and electrical resistance alloys; Flexograin fine-grain phosphor-bronze strip. Riverside, N. J.

Rockwood Pulley Mfg. Co. Inc. 1038
Croft Ritespeed gearmotors; Radiation worm gear reducers; Pollard self-lubricated ball-bearing pillow blocks; Tiger precision-machined conveyor pulleys. 20 Crosby St., New York 13, N. Y.

Rochlen Engraving Works Inc. 1128

Roller Bearing Co. of America 933
Pitchlign roller bearings, sealed roller bearings and roller followers; heavy-duty series bearings; metric cylindrical series bearings; self-aligning bushings, aircraft and industrial type; fractured Pitchlign bearings. Sullivan Way, W. Trenton, N. J.

Geo. D. Roper Corp. 112

Rosan Inc. 806
Fasteners; Inserto hex-drive insert; Press-Nut for sheet metal. 2901 W. Coast Highway, Newport Beach, Calif.

Rotherm Engineering Co. Inc. 402
Single, double, three and four-way revolving joints; expansion joints and piping compensators. 7280 W. Devon Ave., Chicago 31, Ill.

Rubber & Asbestos Corp. 6
Industrial adhesives; Bondmaster industrial adhesives; Plymaster adhesive-coated electrolytic copper for printed circuitry; Plymaster V-2 and V-3 glass mat supported adhesive in film form; Tackmaster pressure-sensitive adhesive in film form. 225 Belleville Ave., Bloomfield, N. J.

Russell Mfg. Co. 820
Teflon, Dacron, glass and other synthetic and natural fibers; engineered fabric products. 1020 E. Main St., Middletown, Conn.

Saginaw Steering Gear Div., General Motors Corp. 122

Sandusky Foundry & Machine Co. 1339
Hollow cylindrical shapes, sections or segments cast centrifugally of standard alloy grades of steel, copper-base alloys, or nickel-base alloys. W. Market St., Sandusky, O.

A. Schrader's Son Div. 137

Scovill Mfg. Co. 1218
Paneloc rotary latches, panel fasteners, high-performance fasteners. 99 Mill St., Waterbury, Conn.

Security Locknut Corp. 735

Edward Segal 1831

Servocontrol Div. (See Oilgear Co.)

Shakeproof Div., Illinois Tool Works 1312
Nibscrew to prevent stripping in sheet metal; Sems preassembled screw and washer fasteners; Keps preassembled nut and washer fasteners; sealing fasteners; lockwashers; miscellaneous fasteners. St. Charles Rd., Elgin, Ill.

Simmons Fastener Corp. 828
Fasteners—Link-Lock, Roto-Lock, Dual-Lock, Spring Lock, Quick-Lock; special industrial fasteners. Albany, N. Y.

Simplatrol Products Corp. 301

SKF Industries Inc. 705
Ball bearings; pillow blocks; cylindrical and spherical roller bearings; Tyson tapered roller bearings. Front St. and Erie Ave., Philadelphia 32, Pa.

Skinner Electric Valve Div., Skinner Chuck Co. 708
Two, three and four-way solenoid valves for air, gases, oils, fuels, water, steam and other media. 95 Edgewood Ave., New Britain, Conn.

Snow-Nabstedt Gear Corp. 807

Southco Div., South Chester Corp. 1239
Lion ¼-turn fasteners; Southco drive (blind) rivets; screw type fasteners; adjustable pawl fasteners; door latches; door retaining springs; drivebolts (blind bolts); threaded inserts. Lester, Pa.

South Florida Test Service 820

Spiroid Div., Illinois Tool Works 1822, 1824
Spiroid gears. 2201 N. Keeler Ave., Chicago 39, Ill.

Stacor Equipment Co. 710
Stacormatic drafting desk; tracing tables. 768 E. New York Ave., Brooklyn 3, N. Y.

Stahlin Brothers Fibre Works Inc. 820

Standard Pressed Steel Co. 416, 420
Self-locking Unbrako socket screw with Nylok locking feature; microsize cap screws, set screws and self-locking locknuts; lightweight self-locking locknuts; Unbrako socket-head set and cap

screws, shoulder screws, pressure plugs and dowel pins; Flexloc self-locking locknuts; Sel-lok spring pins; Hi Ti titanium aircraft bolts; Hi Psi steel aircraft bolts (220,000 psi min). Jenkintown, Pa.

Standard Screw Co. (See Hartford Machine Screw Div.)

Star Expansion Industries 505
Pin-Grip hammer-drive rivets. 142 Liberty St., New York City.

Stearns Magnetic Products (See Indiana Steel Products Co.)

Steel 232

Stephens-Adamson Mfg. Co. 1305, 1307
Sealmaster ball-bearing units; Carveyor system; Speedwalk passenger conveyor system. Aurora, Ill.

Stewart-Warner Corp. (See Alemite Div.)

Stoffel Seals Corp. 838

Stokes Molded Products Div., Electric Storage Battery Co.... 833

Stow Mfg. Co. 302
Power drive flexible shafts; remote control flexible shafts; flexible shaft terminals; remote manual valve controls; rigid reach-rod controls; geared joints; flexible-shaft couplings. 443 State St., Binghamton, N. Y.

Stratoflex Inc. 1815
General industrial and aircraft hose and fittings; medium and high-pressure wire braid hose with reusable fittings; high-temperature Teflon hose and swaged fittings; special aircraft angles and connections; industrial elbows and fittings. Box 10389, Ft. Worth, Tex.

Stratos Div., Fairchild Engine and Airplane Corp. ..801, 802, 804

Stromberg-Carlson Co. Div., General Dynamics Corp. 626
Relays; telephone type jacks and plugs; individual and multiple pushbutton type key switches; stepping switches; telephone handsets; complete telephone assemblies for specific applications; terminal blocks; miscellaneous telephone components. 100 Carlson Rd., Rochester, N. Y.

Strong, Carlisle & Hammond (See Mac-It Screw Div.)

Superior Steel & Malleable Castings Co. 718
Engineered castings; Checkerboard cast alloy steel. Benton Harbor, Mich.

Superior Tube Co. 414
Small-diameter seamless and Weldrawn metal tubing from 0.010 to ⅝-in. OD in carbon and alloy steel, stainless steel, nickel and nickel alloys, reactive metals, titanium, zirconium and zirconium alloys. Box 191, Norristown, Pa.

Sweet's Catalog Service, F. W. Dodge Corp. 437

Sylvania Electric Products Inc. 110
Molded plastic products; wire and ribbon products in special sizes, shapes and materials; electronic components in metal and plastic; fluorescent wire devices. 1740 Broadway, N. Y. 19, N. Y.

Tann Corp. (See Fluidwick Co.)

Thermoid Co. 510

Thomas Flexible Coupling Co. 1228
Flexible couplings for mechanical power transmission. Main Ave and Biddle St., Warren, Pa.

Thomas Register of American Manufacturers 1220

Thompson-Bremer & Co. Div., American Machine & Foundry Co. 842
Everlock tooth type lockwashers; Everlock Sems (preassembled screw and washers); free-spinning, tyne-type locknut. 520 N. Dearborn St., Chicago 10, Ill.

Thomson Industries Inc. 432
Ball Bushings—ball bearings for linear motion; Nylined nylon bearings; 60 Case hardened and ground shafting; nylon universal joints; Thriftmaster multiple-spindle drillheads. 1029 Plandome Road, Manhasset, N. Y.

Tinnerman Products Inc. 1001
Speed Nut fasteners; multipurpose fasteners; Speed Grip nut retainers and bolt retainers; eight-point contact Speed Nuts for hard-chrome studs. P. O. Box 6688, Cleveland 1, O.

Geo. A. Tinnerman Corp., Pneuma-Serve and Radarm Div... 1645
Pneuma-Serve automated screw feeder; Radarm self-balancing tool mount for vertical alignment of power tools within 30-in. radius. 19930 Detroit Rd., Box 2805, Cleveland 16, O.

Torrington Co. 15, 17
Bearings; swaging machines; special metal parts. Torrington, Conn.

Townsend Co. 1139
Lockbolts; Cherry blind rivets; Versa rivets; Tuff-Tite screws; special cold formed parts; tubular rivets; tapping screws. Box 237, New Brighton, Pa.

Toyad Corp. 1039
Chemfoam cellular products with special properties; custom-molded foams for specific applications. Plant Rd., Latrobe, Pa.

Tru-Seal Div. (See Flick-Reedy Corp.)

Union Carbide and Carbon Corp. (See Bakelite Co., Electro Metallurgical Co., Haynes Stellite Co., Linde Air Products Co.)

United-Carr Fastener Corp. 1044

United Shoe Machinery Corp. 1839
Pop blind rivets; Pop hydraulic-pneumatic hand guns. Boston 7, Mass.

U. S. Dept. of Commerce 114

U. S. Electrical Motors Inc. 1644
Uniclosed induction motors; Syncrogear gearmotors; Varidrive variable speed drives; Varitrol automatic control for Varidrives; Varidyne variable speed system for ac induction motors; totally-enclosed induction motors. 200 E. Slauson Ave., Los Angeles 54, Calif.

United States Gypsum Co. 1501
Expanded metals. 300 W. Adams St., Chicago 6, Ill.

United States Plywood Corp. 325

U. S. Rubber Co., Mechanical Goods Div. 822

United States Rubber Co., Royalite Div. 809, 811, 815

United States Steel Corp. 1527, 1531, 1533
T-1 high-strength, weldable steel with impact resistance and low-temperature toughness; Cor-Ten, Man-Ten and Tri-Ten high-strength steels; forgings; extrusions; Tenalon, USS 12 MV and AD 2000 stainless steels for aircraft use; specialty products. 525 William Penn Place, Pittsburgh 30, Pa.

U. S. Stoneware Co. 1229
Alite high-temperature, high-strength ceramics; Tygoweld bonding process; custom-molded and extruded rubber and plastic parts. Akron 9, O.

Valcor Engineering Corp. 808
Industrial and military solenoid valves. 365 Carnegie Ave., Kenilworth, N. J.

Veeder-Root Inc. 123
Counting devices and instruments; small square-case miniature counters; small reset ratchet counter; high-speed mechanically driven counters; medium-size moderate-duty counters; electrically-operated counters for remote indication; predetermining counters for production control. Hartford 2, Conn.

Wagner Electric Corp. 523, 524
Fractional and integral horsepower single-phase motors; integral-horsepower polyphase motors, drip-proof and enclosed types; industrial brakes, actuators and controls; hydraulic and air systems and components for stopping, holding, tensioning and positioning applications. 6400 Plymouth Ave., St. Louis 14, Mo.

Waldes Kohinoor Inc. 1010
Truarc retaining rings, retaining-ring pliers, grooving tools, and applicators and dispensers; Waldes positive lock fastener; Nylon-Zip slide fasteners; grip ring applicator; mechanized assembly equipment; Waldes QAF quick-action stressed panel fastener. 47-16 Austel Place, Long Island City 1, N. Y.

Warner Electric Brake & Clutch Co. 1636
Fail safe and power brakes. Beloit, Wis.

Weatherhead Co., Fort Wayne Div. 332
Flareless brass and steel tube fittings; reusable hose ends; bulk hose and hose assemblies. 128 W. Washington St., Ft. Wayne, Ind.

Weckesser Co. 1214
Nylon, ethyl cellulose and Teflon cable clamps; nylon snap clips; nylon perforated strapping; D-washers; molded nylon screws and nuts; nylon continuous threaded rod; nylon set screws; molded nylon cap nuts; nylon washers; plastic and metal stampings. 5701 Northwest Highway, Chicago 30, Ill.

S. K. Wellman Co. 12
All-metal clutch plates, facings, disks, and brake linings; nonmetallic clutch disks; button-type clutch plates; all-metal brake blocks. Bedford, O.

Westinghouse Electric Corp. 209
Industrial Micarta plastic parts; industrial insulating tapes; copper-clad Micarta; polyester molded items. 401 Liberty Ave., Pittsburgh 22, Pa.

Westline Products Div., Western Lithograph Co. 1428
Protective coatings; labels and tags; wire and insulation markers; masks; adhesive-cloth tapes; adhesive-paper tapes. 600 E. 2nd St., Los Angeles 54, Calif.

Westplex Corp. 1833
Nylon gears. 12 Commercial St., Rochester 14, N. Y.

S. S. White Dental Mfg. Co., Industrial Div. 1515
Flexible shafts; industrial airbrasive unit. 10 E. 40th St., N. Y. 16, N. Y.

Whitney Chain Co. 322
Roller, silent, and conveyor chain; sprockets; Whitney-Tormag magnetic drives. 237 Hamilton St., Hartford, Conn.

Edwin L. Wiegand Co. 1525

Wittek Mfg. Co. 1208
Hose clamps, including Army and Navy approved types. 4305 W. 24th Place, Chicago 23, Ill.

Yale & Towne Mfg. Co., Powdered Metal Products Div...... 1226
Powdered-metal parts—automotive, communications, appliance, projection equipment, recording, and miscellaneous. 9335 W. Belmont Ave., Franklin Park, Ill.

Zenith Electric Co. 1207
Magnetic switches and timing controls; electrically or mechanically locked transfer switches; 30 to 400-amp magnetic contactors; program clocks; multicircuit cycle timers; automatic reset timers. 152 W. Walton St., Chicago, Ill.

PHOTO CREDITS

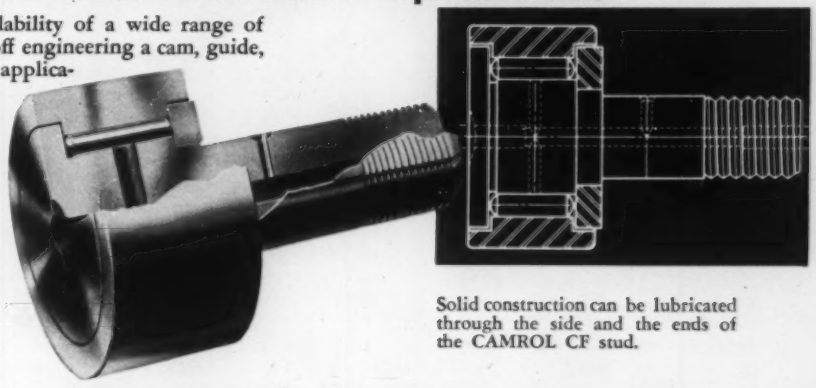
Page 157: Aerojet-General Aerobee-Hi rocket. Pages 158 and 159, counterclockwise: North American X-10 supersonic test vehicle; Frigidaire automatic clothes washer; earth satellite; Admiral transistor radio and Sun Power Pak; Sheffield thread roller; Chevrolet Super Sport Corvette; Bell & Howell automatic-iris movie camera; Convair B-58 Hustler.

BEARING TIPS by McGill

For convenience, with savings in time and cost

Use McGILL® CAMROL Cam Followers instead of improvised units

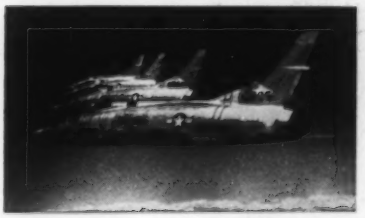
Simplification of design with availability of a wide range of standard bearings takes the strain off engineering a cam, guide, support or track roller bearing application. No need to "build up" a special unit when you can select the proper size standard CAMROL bearing engineered especially for the job. McGill's CAMROL bearing construction offers full type capacity, with provision for shock, in a compact precision unit. Specify CAMROL, the original cam follower, in either CF (with stud) or CYR (shaft mounting) series. Sealed and prelubricated bearing available also.



Solid construction can be lubricated through the side and the ends of the CAMROL CF stud.

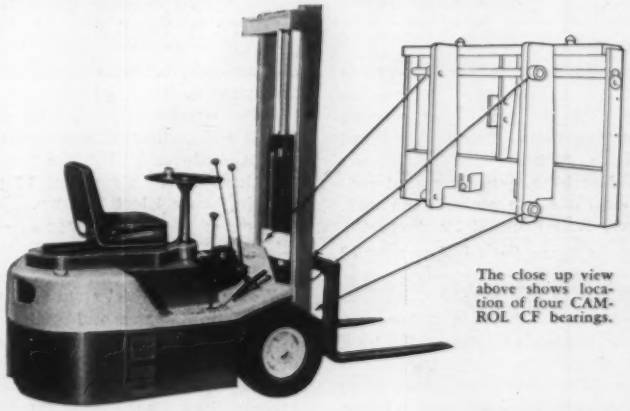
YR bearings help F-100 Super Sabre make slower and safer landing

The supersonic speeds obtained by today's modern aircraft set up design problems not encountered with older, slower planes. The overall streamlined design required for speed in flight, for instance, necessitated finding ways of supporting the North American F-100 Super Sabre at low air speeds required for landing. A



series of slats on the leading edge of the wing, providing greater lift at lower air speed, was the answer. Each slat is supported by McGill CAMROL YR bearings — especially designed to permit shaft or yoke mounting. These long-life bearings carry the loads of these slats as they move on tracks during flight of the Supersonic F-100.

CAMROL CF bearings out-perform friction rollers as fork support bearings



The close up view above shows location of four CAMROL CF bearings.

Small size and high load-carrying unit construction with simplified lubrication are among principal benefits obtained by Hyster Company from use of CAMROL CF bearings as fork support rollers in its Hyster 20 and other lift trucks.

Two bearings ride up and down inside each vertical mast section to position the lift truck fork under load. Speeds are relatively slow but the crushing loads on each bearing are heavy.

In this particular application, the exterior surfaces of the bearings are treated with a black oxide finish. This provides corrosion-resistance which serves to augment maintenance-free operation, a characteristic of CAMROL bearing construction.

Fact-packed Bearing Catalog

Write for your copy of Catalog 52-A, a revised, 128-page Bearing Selection Guide.

Insure performance with McGILL®

MULTIROL® GUIDEROL® CAMROL
Precision Needle Bearings

McGILL MANUFACTURING COMPANY, INC., 200 N. LAFAYETTE ST., VALPARAISO, INDIANA

Helpful Literature
for Design Executives

For copies of any literature listed, circle Item Number on Yellow Card—page 19

Air & Hydraulic Cylinders

Dimensional drawings for six models of Squarehead S line cylinders with pressure ratings of 250 psi air and from 500 to 1000 psi hydraulic are featured in bulletin S-101. Bores range from 1½ to 6 in. How-to-order data are included. 8 pages. Teer-Wickwire & Co.

Circle 751 on page 19

Self-Locking Nuts

Locking principle of Nylok self-locking nuts is explained in bulletin ADV-697-R2 which also lists nuts' characteristics. Nuts are made in ¼ to 1-in. sizes with maximum installation torques from 15 to 400 lb-in. 4 pages. Republic Steel Corp., Bolt & Chain Div.

Circle 752 on page 19

Roll Formed Shapes

Company facilities for producing roll formed shapes are pictured in catalog 1555 along with simple and complex sections being produced from both ferrous and nonferrous metals. Notching, punching and cutting operations are pictured as well. 26 pages. Roll Formed Products Co.

Circle 753 on page 19

Dial Indicators & Gages

Comprehensive bulletin 416 covers complete range of dial indicators, dial gages and instruments. Indicators are made with graduations from 0.0001 to 0.001-in. with total ranges from 0.020 to 1 in. and in 140 models to meet exact requirements. 80 pages. L. S. Starrett Co.

Circle 754 on page 19

Slip Ring Assemblies

Bulletin S-2056 describes complete slip ring assemblies, brush holder assemblies, brush and leaf assemblies and contacts which are designed to specification. 4 pages. Superior Carbon Products, Inc.

Circle 755 on page 19

Fans & Blowers

Bulletins SDA-160 and SDA-200 respectively describe fans and blowers, and belt drive utility blowers. Former covers horizontal and vertical ventilating fans, industrial units and 1/6 to 7½-hp blowers. Latter provides performance data and dimensions of non-overloading belt drive utility blowers with 686 to 26,044 cfm deliveries. 18 and 34 pages. Peerless Electric Co.

Circle 756 on page 19

Stainless Steel Sheet

"Care and Use of 430 MicroRold Stainless Steel" is explained in brochure of this title. MicroRold sheets are available in thicknesses from 0.005 to 0.109-in. while Verithin MicroRold strip comes in 0.0015 to 0.009-in. thicknesses. 12 pages. Washington Steel Corp.

Circle 757 on page 19

Pushbuttons

Pushbutton selector guide B 6749 catalogs complete line of general purpose, water and dust-tight, explosionproof, corrosion resistant, Oiltite, palm or foot operated, and foot treadle operated pushbuttons, stations and units. Contact arrangements, features and prices are listed for these ac or dc units. 72 pages. Westinghouse Electric Corp.

Circle 758 on page 19

Worm Gear Jacks

Worm gear jacks in capacities from 5 to 50 ton and with raising actions from 3 to 25 in. are subject of form AD-34a. Applications are pictured and dimensional drawings are provided. Used in multiple groups, jacks always raise in perfect unison. 8 pages. Duff-Norton Co.

Circle 759 on page 19

High Speed Motion Pictures

"High Speed Motion Pictures at the Service of the Engineer" is title of brochure F1-2 which depicts the use of the Kodak high speed camera in industry. Data on film and facts about the camera which can slow down action up to 200 times are presented. 12 pages. Eastman Kodak Co.

Circle 760 on page 19

Machine Tool Limit Switches

Loxswitch machine tool limit switches are detailed as to construction and operation in bulletin 956. Wiring diagrams are presented on two and three-pole, snap-action and neutral-position switches with slow make and break. Switches are made in 125, 250, 500 and 600-v ratings. 8 pages. R. B. Denison Mfg. Co.

Circle 761 on page 19

Flow Control Device

The Mesurflow control can maintain one set rate of fluid flow regardless of variable inlet pressures. Folder 231 describes this flow control as well as valves incorporating it in their design. Flow rates range up to 8 gpm. 8 pages. Hays Mfg. Co.

Circle 762 on page 19

Seamless Tubing

Company facilities for producing mechanical seamless, electric resistance welded, aircraft seamless and forged and fabricated tubing are pictured in form CF-2. Seamless tubing is produced in sizes from ¼ to 7 in. OD. 14 pages. Copperweld Steel Co., Ohio Seamless Tube Div.

Circle 763 on page 19

Variable Speed Drive

The Speed Variator is a precision mechanical variable speed drive with input ratings up to 10 hp in the type K and to 16 hp in the type KL, both at 1750 rpm. Speed range ratios of these two models are up to 9:1 and 6:1, respectively. Complete design and application data are given in booklet K-200. 8 pages. Cleveland Worm & Gear Co.

Circle 764 on page 19

Steel Plate

Bulletin 541 gives analysis, physical properties and fabricating data on Speed Case steel plate. This free-machining, open hearth, low carbon steel is particularly suited for making molds, gears, flywheels, dies, jigs, fixtures, sprockets and hundreds of other parts. 8 pages. W. J. Holliday & Co.

Circle 765 on page 19

Extruded Aluminum Shapes

"ALCOA Offers a New Horizon in Extruded Shape Design" is title of illustrated brochure which explains potential advantages offered by the new 14,000-ton extrusion press re-

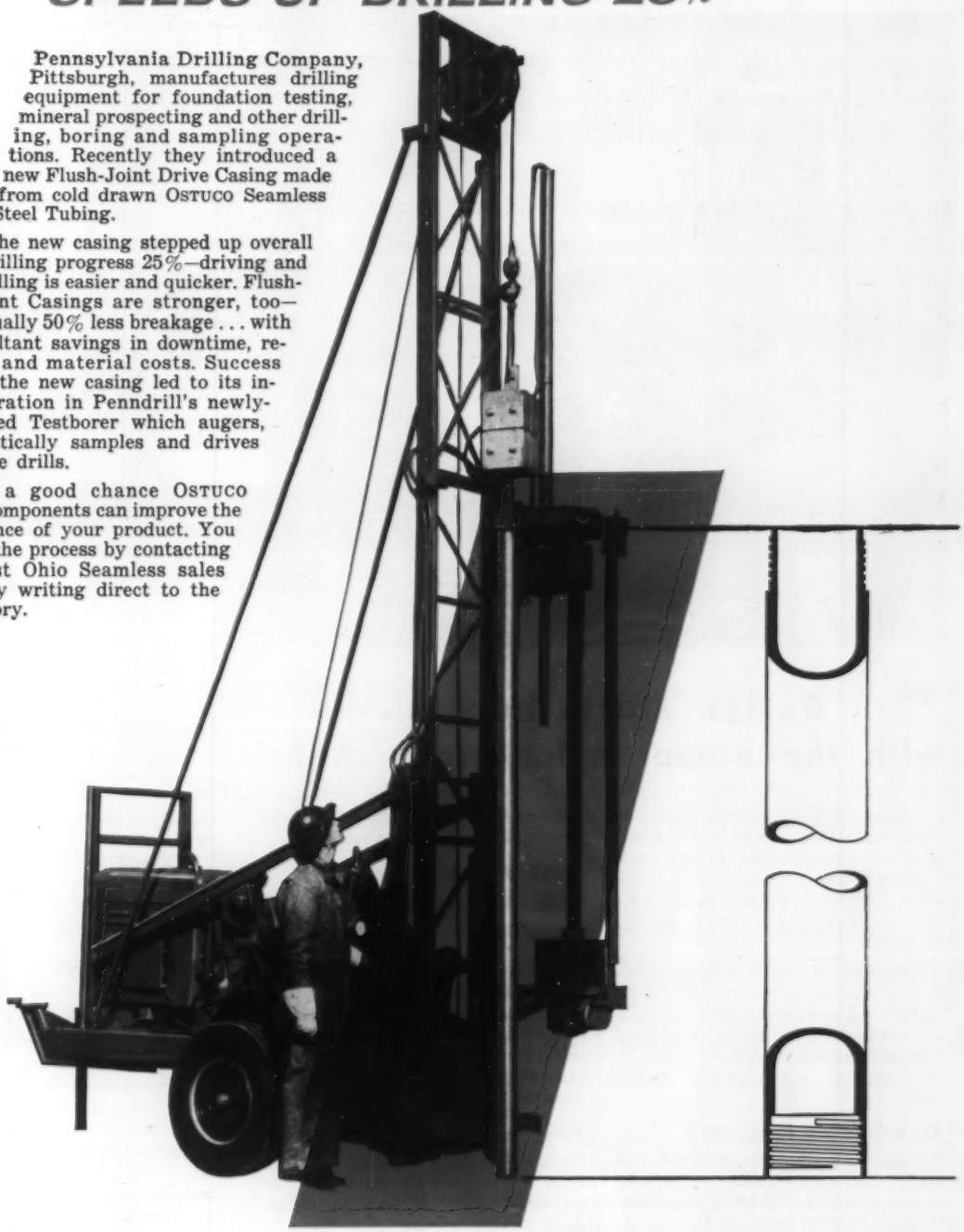
OHIO SEAMLESS TUBING

SPEEDS UP DRILLING 25%

Pennsylvania Drilling Company, Pittsburgh, manufactures drilling equipment for foundation testing, mineral prospecting and other drilling, boring and sampling operations. Recently they introduced a new Flush-Joint Drive Casing made from cold drawn OSTUCO Seamless Steel Tubing.

The new casing stepped up overall drilling progress 25%—driving and pulling is easier and quicker. Flush-Joint Casings are stronger, too—actually 50% less breakage . . . with resultant savings in downtime, repair and material costs. Success with the new casing led to its incorporation in Penndrill's newly-designed Testborer which augers, automatically samples and drives and core drills.

There's a good chance OSTUCO Tubing components can improve the performance of your product. You can start the process by contacting the nearest Ohio Seamless sales office, or by writing direct to the Shelby factory.



OSTUCO TUBING

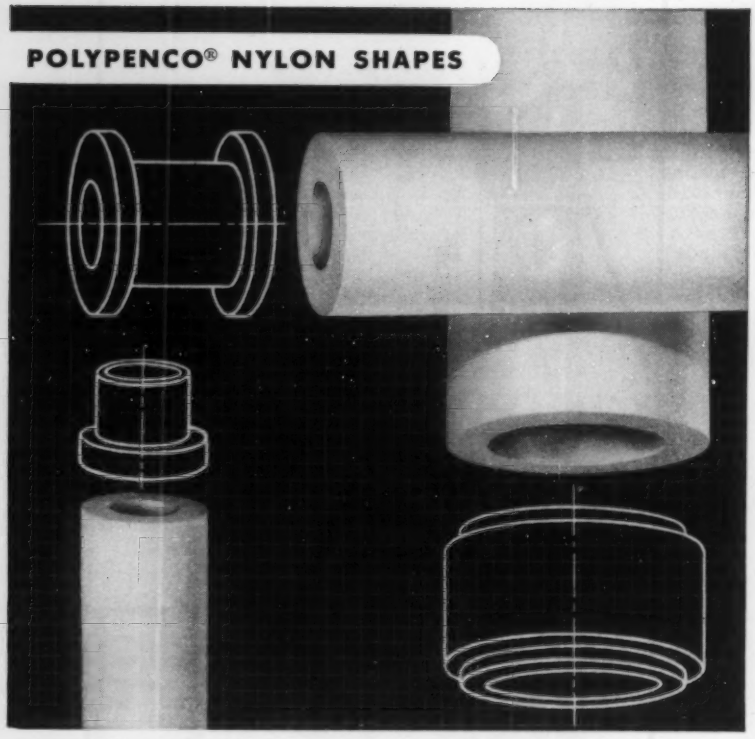
MANUFACTURED IN
SHELBY, OHIO
EXCLUSIVELY BY

OHIO SEAMLESS TUBE DIVISION
OF COPPERWELD STEEL COMPANY

SHELBY, OHIO • Birthplace of the Seamless Steel Tube Industry in America
SEAMLESS AND ELECTRIC-RESISTANCE WELDED
STEEL TUBING • FABRICATING • FORGING

SALES OFFICES: Birmingham • Charlotte • Chicago (Oak Park) Cleveland • Dayton • Denver • Detroit (Ferndale) • Houston Los Angeles (Beverly Hills) • Moline • New York • North Kansas City • Philadelphia (Wynnewood) • Pittsburgh • Richmond Rochester • St. Louis • St. Paul • St. Petersburg • Salt Lake City Seattle • Tulsa • Wichita
CANADA: Railway & Power Engr. Corp., Ltd.
EXPORT: COPPERWELD STEEL INTERNATIONAL COMPANY, 225 Broadway, New York 7, New York

Circle 485 on page 19



Design starts here . . . with the proper nylon stock shape

• Here are tubular bars made of Polypenco nylon . . . produced to eliminate drilling operations, reduce stock costs per foot . . . manufactured under rigid controls to provide nylon with uniform density, controlled physical properties.

• Designers specify Polypenco nylon shapes because parts can be machined rapidly, at low cost, and to close tolerances . . . and because they have complete control over every phase of production, maintaining design flexibility.

Outstanding Properties

Nylon parts are wear resistant and resilient with an excellent strength to weight ratio. They provide low coefficient of friction requiring little or no lubrication—plus noise dampening and non-galling or abrasive characteristics. They resist most chemicals and have good electrical insulating properties.

Stock Shape with Wide Application

Polypenco nylon rod, tubular bar, strip and plate are available for quick conversion to parts such as gears, bearings, rollers, valve seats, thrust washers, wear strips, and many other applications in food and beverage industries, machine tools, etc. Stock is immediately available from warehouses throughout the country.

Fabricating Service

Custom fabricated parts are available from The Polymer Corporation of Pa., engineered for the best in design, quality and tolerances.

See POLYMER Booth No. 832
Design Engineering Show
New York City—May 20-23

THE POLYMER CORPORATION OF PENNA.
Reading, Penna.
Export: Polypenco, Inc., Reading, Penna., U.S.A.

POLYPENCO

POLYPENCO nylon, POLYPENCO Teflon†, NYLAFLOW® and NYLATRON® GS †DU PONT TRADEMARK

Helpful Literature

cently installed at company's Lafayette, Ind. plant. Design influence of press, typical cross-section extruded shapes, and manufacturing limitations and tolerances are some of the data covered. 32 pages. Aluminum Co. of America.

Circle 766 on page 19

Stainless Steel Fastenings

Over 7000 different types and sizes of stainless steel fastenings are cataloged in guidebook No. 56-A. Specifications are given on cap, machine, sheet metal, wood, set and other screws; nuts; washers; pipe fittings and screw machine products. Also listed are thirty different types of continuous and butt hinges made of stainless steel. 24 pages. Star Stainless Screw Co.

Circle 767 on page 19

Oscilloscope

Details of the model 411A wideband oscilloscope for laboratory, testing and design functions are given in bulletin 411A. Easy to operate, it covers a band width from direct current to 10 megacycles. 4 pages. Laboratory for Electronics, Inc.

Circle 768 on page 19

Fine Pitch Gears

Precision gears are compared to commercial gears in illustrated brochure "Precision Fine Pitch Gears." Section is devoted to latest recommended gear data. Production facilities, examples of gearing and typical spur, helical, bevel, Hypoid, Zerol, Spiroid, worm and spiral bevel gears as well as rack and sectors are shown. 16 pages. Fairchild Camera & Instrument Corp.

Circle 769 on page 19

Bronze Bearings & Parts

Illustrated bulletin No. 1 "Bunting Sintered Bronze Bearings and Sintered Metal Parts" deals with parts made by powder metal techniques. Complete engineering and design data are presented on bushings, bearings, bars and special parts of cast bronze and powdered metal. 24 pages. Bunting Brass & Bronze Co.

Circle 770 on page 19

Colored Aluminum Strip

Handsomely-finished aluminum products in a variety of organic finished colors can be produced on standard roll-forming machines, press brakes, or draw or punch presses by using Colorweld. Complete data on this pre-enameled, prefinished aluminum coil stock in ½ to 36-in. widths

The only Belt Drive that replaces uncertain friction grip with POSITIVE TOOTH ENGAGEMENT!

Gilmer

THE ORIGINAL

"TIMING" BELT
Power Transmission Drive

Just look at all the money-saving advantages that stem directly from this unique "Timing"® Belt feature:

There is no belt slippage or creep, therefore:
- Constant angular velocity is transmitted;
- Precision *timing* is maintained between shafts;
- Practically 100% efficiency is obtained;
- Belt and pulleys last much longer.

No initial belt tension is required, therefore:
- Belt's rated horsepower is all *working* horsepower;
- Bearing loads are minimized, and wear reduced;
- Take-up adjustments are eliminated.

Less belt-pulley contact area is needed, therefore:
- Drives can be more compact, take less space;
- Smaller-diameter pulleys can be used;
- Higher drive ratios are practical.

Additionally, the "Timing" Belt drive needs no lubrication. Rating for rating, its cost is usually the lowest...especially when you can take advantage of stock drives.

A factory-trained Power Transmission Field Engineer will gladly help you adapt the "Timing" Belt's many unique advantages to your product's drives—from "fleapower" to over 1,000 horsepower!

NYB&P — NEW YORK BELTING & PACKING CO. — Founded 1846

NEW YORK BELTING & PACKING CO. 1 Market St., Passaic, N. J.

America's Oldest Manufacturer of Industrial Rubber Products

CAMLOC *low cost/light weight*

5F series

Camloc's new small, lightweight 5F Series features high strength-weight ratio plus the quick-operating advantages of a ¼-turn fastener... in a size and weight that offers new design possibilities to original equipment manufacturers! Particularly adaptable to thin materials and miniaturized equipment like airborne electronics, small electro-mechanical and computing devices and communications components. Ideal for attaching lightweight components in "packaged" equipment or for holding access panels on everything from washing machines to radar units.

Offered in many different head styles. Complete specifications will be sent to you on request.

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37 Spring Valley Road, Paramus, N. J.

WEST COAST OFFICE: 5410 WILSHIRE BLVD., LOS ANGELES, CAL.
FORT WORTH OFFICE: 2509 W. BERRY ST., FORT WORTH, TEXAS

Circle 488 on page 19

Helpful Literature

and 0.016 to 0.051-in. thicknesses are given in bulletin C101. 4 pages. Reynolds Metals Co.

Circle 771 on page 19

Chains & Sprockets

Extensive technical data, including specifications, application and selection information, are contained in comprehensive catalog 899 on chains and sprockets. Twenty-nine standard chain types, plus special types are detailed, along with variety of sprocket wheel types, jaw clutches and clutch couplings. Dimensional drawings are included. 224 pages. Jeffrey Mfg. Co.

Circle 772 on page 19

Electric Oven Control

Designed for use on cooking ranges, two electric oven controls are described in illustrated bulletin RT-789. The on-off switch, temperature setting and pilot light are actuated by a single dial. 4 pages. Robertshaw-Fulton Controls Co.

Circle 773 on page 19

Fasteners

"Chicago Standard Fasteners" shows production facilities and typical fasteners which comprise this line. Pictured are socket set and cap screws; flat, button, fillister and hex head cap screws; dowel and taper pins; and hex and castle nuts as well as many other fasteners which are available from stock or to order. 6 pages. Chicago Screw Co.

Circle 774 on page 19

Access Latches

Details of complete line of cowling and access latches, especially adaptable for aircraft application, are given in brochure AD 339. Lightweight cowling latches are capable of handling tensile loads of 7500 lb without deformation. Access latches take loads up to 3000 lb. Simmonds Aerocessories, Inc.

Circle 775 on page 19

Friction & Rubber Tape

Available sizes and properties of Bull Dog brand friction, rubber and plastic tape are listed in bulletin 730. Packaging and display cartons are shown. 4 pages. Boston Woven Hose & Rubber Co.

Circle 776 on page 19

Analog Computer

Building-block design employed in the model 3000 analog computer and its problem-handling capacity are subject of illustrated bulletin. Flexi-

WHY PAY MORE
for specials, when you can get what you need FROM STOCK?

Design around
BOSTON Gear
100 SERIES
SPEED REDUCERS
1605
types and ratios
FROM STOCK

Horizontal Right Angle Drive
Worm Gear over

Horizontal Right Angle Drive
Worm Gear under

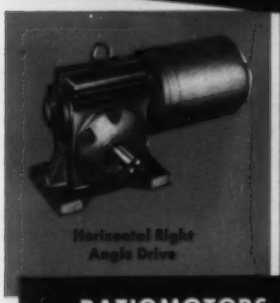
REDUCTORS Ratios 1:1 to 3600:1 — .004 to 50 HP

FROM STOCK!
Vertical Right Angle Drive

Double Reduction Horizontal Parallel Drive

Horizontal Right Angle Drive

Double Reduction Vertical Right Angle Drive


Horizontal Right Angle Drive

Double Reduction Horizontal Parallel Drive

RATIOMOTORS Output RPM .49 to 175

FROM STOCK!
Vertical Right Angle Drive

Double Reduction Vertical Right Angle Drive

All Ratiomotors also sold without motors as
FLANGED REDUCTORS

FROM STOCK!
You buy and attach your choice of motor

And now MORE SIZES in small REDUCTORS

Meet increasing needs for smaller units in Horizontal Right Angle Drive models. Boston Gear Works, 64 Hayward St., Quincy 71, Mass.

Catalog No. 56
lists full specifications, includes 50 pages of engineering data to aid in selection and application.

CALL YOUR **BOSTON** Gear **DISTRIBUTOR**

Visit BOSTON GEAR Booth No. 206 at the DESIGN ENGINEERING SHOW

IT PAYS TO HAVE HUBBELL GOOD CONNECTIONS

PRECISION MACHINE SCREWS

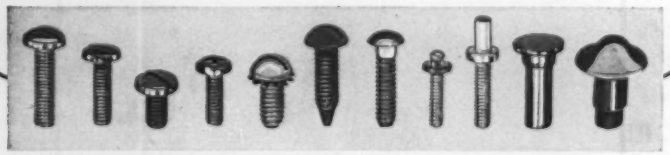
Make it Easier to Sell!

. . . because with high quality fasteners your product earns a reputation for better performance and longer life service. Experience proves that the initial higher cost of quality components is offset time and time again by such things as operating efficiency, good appearance, better accuracy, etc.

Better Steel means Better Quality

The carbon steel heading wire used in the production of standard Hubbell Screws is A.I.S.I. Grade C-1010. Special application screws with higher strength or torque value requirements are produced from A.I.S.I. Grades C-1013, C-1020 and C-1035. Those subjected to drilling or subsequent tapping operations are produced from A.I.S.I. Grades C-1108 or C-1110.

All carbon steel wire used in the production of Hubbell screws, regardless of grade, is annealed in process material to specified tensile strength and is drawn to restricted size tolerance to insure the high Hubbell standards of quality and size in the finished screws.



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HARVEY HUBBELL, INC.

HIGHEST QUALITY
WIRING DEVICES • MACHINE SCREWS

OVER 60 YEARS' EXPERIENCE in the manufacture of highest quality, rolled thread machine screws and special cold headed parts.

MACHINE SCREW DEPARTMENT BRIDGEPORT 2, CONNECTICUT

Helpful Literature

bility of this equipment for product development, process simulation and research is explained. 6 pages. Donner Scientific Co.

Circle 777 on page 19

Liquid Chillers

Described in illustrated catalog 511, six Flow-Cold packaged liquid chillers for air conditioning and refrigeration purposes are available in capacities of 3 to 20 tons. Suitable also for industrial processing, chillers are compact and self-contained. Acme Industries, Inc.

Circle 778 on page 19

Stainless Ball Valves

Type 316 stainless steel ball valves with Teflon seats and trim are available in up to 8-in. sizes for chemical, processing, food and other services. Full data on these quarter-turn controls for —100 to 400° F service at up to 600 psi are given in illustrated bulletin. 4 pages. Rockwood Sprinkler Co.

Circle 779 on page 19

Bevel Gears

1956 revision of the booklet "20° Straight Bevel Gear System" contains complete design and engineering data on this gearing. Formulas to be used in calculating gearing in accordance with latest revisions, adopted by AGMA, are presented. 24 pages. Gleason Works.

Circle 780 on page 19

Magnetic Clutches

Entitled "The World's Finest Magnetic Clutch," bulletin M-101 gives specifications on stationary field, spring-engaged electrically-released and rectifier models of these new magnetic clutches and brakes. Torque capacities of clutch range up to 48,000 lb-in. running and up to 34,000 lb-in. on starting loads. 6 pages. Fawick Corp., Fawick Airflex Div.

Circle 781 on page 19

Rectilinear Recorders

Design features and specifications for single and two-channel rectilinear galvanometric recorders are presented in illustrated bulletins R-501 and R-502. Both inscribe a signal in a form that can be measured with a ruler. 6 pages each. Texas Instruments Inc., Industrial Instrumentation Div.

Circle 782 on page 19

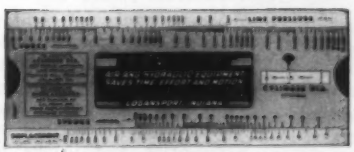
Miniature Fasteners

Reference card is condensed list of stock stainless steel miniature

Illustrated—Logansquare Cylinder.
Meets J.I.C. Standards

Look to Logan

the ultimate in air cylinder design



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Circle 491 on page 19

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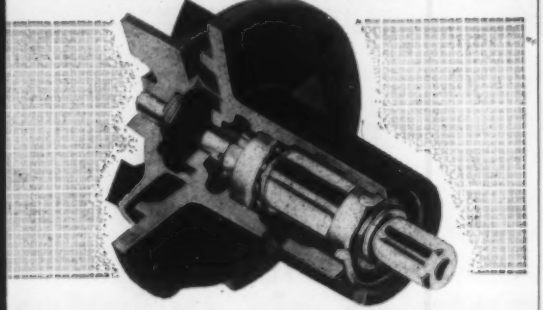
Eliminate failures—Due to swelling, warping, sticking and gumming. Morganite is chemically inert, imparts no taste, odor or colors—provides trouble-free operation in the presence of high temperatures and pressures, oil, water, corrosive chemicals, gases. Proven-in-service on food machinery, fuel pumps, liquid meters, compressors, enameling conveyors, jet engine pumps, pipe lines, process equipment.

Some of the first mechanical seal pumps using carbon seals, one of which is illustrated below, were equipped with Morganite...



...today Morganite is used in aircraft and other modern pumps for trouble-free operation.

Designers! Engineers!—Morganite solves complex lubricating problems. Ask for complete information on Morganite Self-Lubricating Bearings, Pump Vanes, Gland and Piston Rings and other components. Morganite engineers will make recommendations on request.

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Helpful Literature

fasteners. Listed types include machine screws, nuts, washers, set screws, hex head screws and socket set screws. 2 pages. Albany Products Co.

Circle 783 on page 19

Titanium

Data on the application and fabrication of titanium alloys is presented quarterly in the Rem-Cru Titanium Review, now in its fifth year of publication. It is sent regularly to those qualifying. Rem-Cru Titanium Inc.

Circle 784 on page 19

Electronic Relays

Application, construction and engineering specifications for open and hermetically sealed electronic relays are outlined in illustrated catalog 1050. Dimensional drawings and circuit diagrams for eight relay groups are featured. 8 pages. Essex Wire Corp., RBM Div.

Circle 785 on page 19

Power for Pumping

"Selecting Power for Pumping" is a handbook (DE716) that contains a checklist of features necessary for continued dependable operation on pumping jobs. Engine requirements are outlined and examples of efficient installations are given. Diesel engines available are listed. 12 pages. Caterpillar Tractor Co.

Circle 786 on page 19

Dispersions

Forty-four colloidal and semicolloidal dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide, acetylene black, copper and glass are listed in bulletin 2208. Carriers and diluents for each product, typical applications and physical data are given. 4 pages. Acheson Colloids Co.

Circle 787 on page 19

Industrial Photo Light

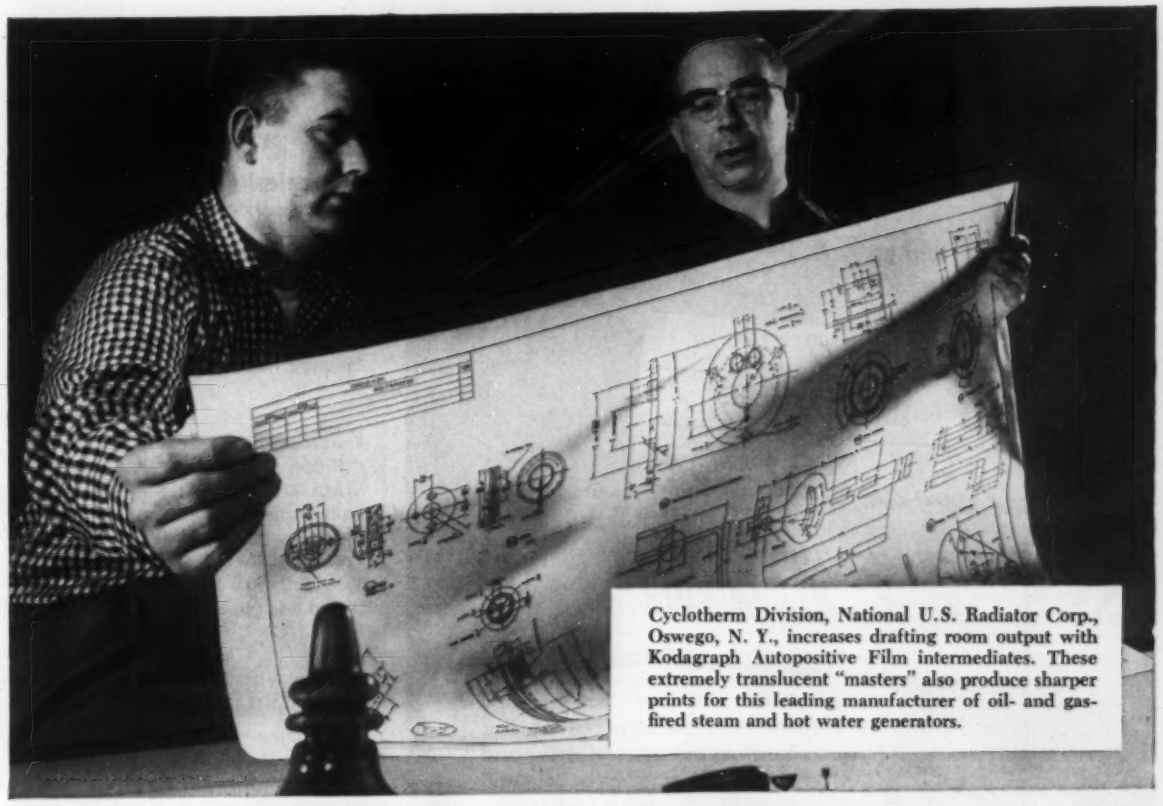
Single packaged light source, the type B Hinelight, produces shadow-free illumination for the industrial photographer by providing a field of light over a 50-degree working angle. Bulletin H257 describes the light, its accessories and shows unretouched photos produced with it. 4 pages. Hinelight Corp.

Circle 788 on page 19

Thermostats

Stemco type A bimetal disk thermostats for electronic, appliance and industrial applications are described in illustrated bulletin 3000. Operating principle, performance data, ratings

Circle 492 on page 19



Cyclotherm Division, National U.S. Radiator Corp., Oswego, N. Y., increases drafting room output with Kodagraph Autopositive Film intermediates. These extremely translucent "masters" also produce sharper prints for this leading manufacturer of oil- and gas-fired steam and hot water generators.

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Circle 493 on page 19

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FROM W.H.
Believe we could sell more chain if we had a complete line like UNION'S
Yes, you could! The fact is you'd have maximum profit potential. For we make all types of steel drive and conveying chain plus sprockets and attachments. No matter what the chain needs of your customers and prospects, you could supply them. You could also call on the engineering knowledge and technical sales assistance of engineers trained in all types of chain, all types of applications. That could add up to more profit too. We'll answer your inquiry promptly.
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The Union Chain And Manufacturing Company
SANDUSKY, OHIO

Helpful Literature

and other information are given. 2 pages. Stevens Mfg. Co.

Circle 789 on page 19

Mechanical Packings

Technical details on Chemlon chemically inert mechanical packings fabricated from Teflon are provided in illustrated bulletin P-325. Covered are 15 types of braided rings, six types of molded cup and cone rings, and combination sets. 8 pages. Crane Packing Co.

Circle 790 on page 19

V-Belting

Folder entitled "What do YOU do When V-Belts Stretch or Break" answers questions on V-belt maintenance, inventory, wear and vibration. Features of Veelos adjustable link V-belting are described and illustrated. 4 pages. Manheim Mfg. & Belting Co.

Circle 791 on page 19

Indexing Machine

"Building block" elements are used to assemble a 65-in. horizontal indexing machine from standard components. These "off-the-shelf" parts are briefly described on illustrated data sheet 505. 2 pages. Hartford Special Machinery Co., Machine Tool Div.

Circle 792 on page 19

Welded Steel Tubing

Partial fabrication of welded steel tubing to special designs lowers overhead and reduces inventory, according to illustrated folder 2656 on Armco Zincgrip or Aluminized steel tubing (types 1 or 2). How finishing operations can be eliminated is related. 4 pages. Armco Steel Corp.

Circle 793 on page 19

Propeller Fans

Two bulletins are offered which describe heavy-duty propeller fans and related package units. Pictures show the widely diversified range of standard sizes and types. Request bulletins FM-1234 and FM-2345. 16 and 24 pages, respectively. Buffalo Forge Co.

Circle 794 on page 19

Automatic Air Filter

Engineering data and capacity tables relative to the Automaze pulse-action automatic air filter are featured in form AMC-256. It combines double filter panel traveling curtain for removing air-borne particles and a pulse-type washout action. It

if it can be pushed through a pipe . . .

you can pump it with a

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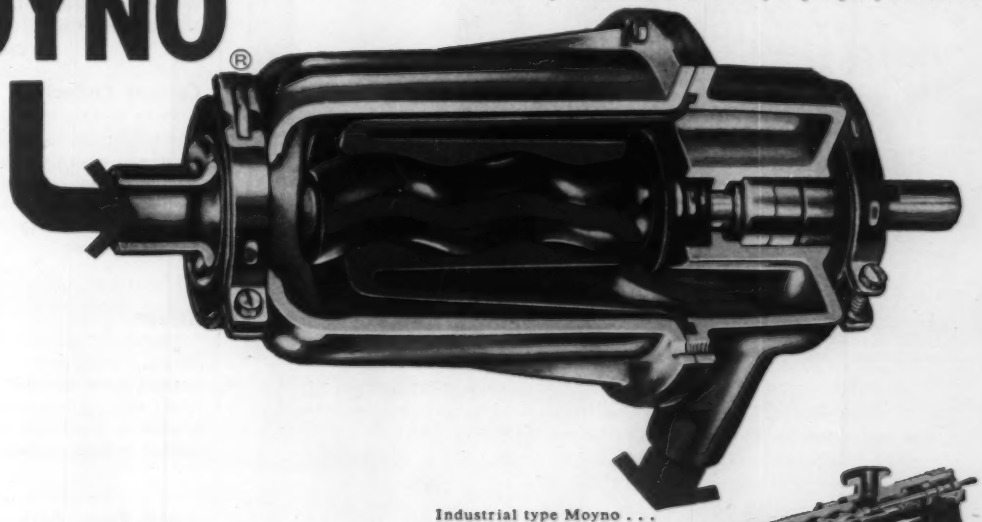
No doubt, in your plant, certain materials are being moved by hand expensively that could be pumped economically by a Moyno. They pump anything that can be forced through a pipe . . . from very thin liquids to heavy, non-pourable abrasive substances . . . even materials containing suspended particles! As the illustration shows, progressing cavities, formed by the helical screw-like rotor turning inside the double-helical stator, move smoothly along, carrying the material with them . . . the cavities don't squeeze the substance . . . can't stick or gum up. Moyno pumps will not cause churning, foaming . . . won't aerate or vapor-lock!

Moynos are adaptable for a wide range of substances simply by modifying the materials the pumping elements are made of. They are available to pull up to 29" of vacuum while discharging under pressure. If you have a pumping problem, chances are a Moyno will solve it!

Write today, for Bulletin 50 MD or look in the yellow pages for name of your nearest R & M Moyno pump representative.



Industrial type Moyno . . . available to 500 gpm, pressures to 1000 psi.

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Helpful Literature

works on viscous impingement principle. 8 pages. Air-Maze Corp.

Circle 795 on page 19

AC Magnetic Starters

Bulletin 6050 descriptively covers multispeed, across-the-line alternating current magnetic starters used to start, stop and change speed of squirrel cage motors. Dimension sheet 6050-DIM supplements this bulletin. 4 pages. Clark Controller Co.

Circle 796 on page 19

Carbon Graphite

Facts about the hardness, mechanical strength, density, wear rate and other properties of Purebon carbon graphite for mechanical applications are found in illustrated catalog 55. Suggested uses, characteristics and design examples of various grades are included. 12 pages. Pure Carbon Co.

Circle 797 on page 19

Welded Fasteners

The RN threaded nut which is resistance welded to appliances, office furniture and heating and cooling equipment to facilitate assembly or improve product design is described in bulletin 562. 4 pages. Ohio Nut & Bolt Co.

Circle 798 on page 19

Current Collectors

Easy installation, low maintenance and minimum conductor wear are advantages resulting from use of Morganite carbon current collectors. Subject of illustrated folder, they are offered in three main types. 4 pages. Morganite Inc.

Circle 799 on page 19

Relays

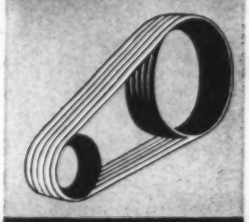
Series of product engineering bulletins, contained in a loose-leaf binder, have detailed descriptions, tables and dimensional drawings of standard, enclosed and hermetically sealed relays. Phillips Control Corp.

Circle 800 on page 19

Small Parts Design Kit

Offered to acquaint designers with the cost-reducing possibilities of tiny precision die castings and thermoplastic moldings, "GRC Product Designers Kit" explains how small parts are mass-produced automatically. Charts compare other methods with GRC techniques of making precision parts to customer's requirements. Available only by writing on letterhead to Gries Reproducer Corp., 400 Beechwood Ave., New Rochelle, N. Y.

TEXROPE



DRIVES

NEW adjustable-speed Magi-Key SHEAVE

- positive locking
- greater design hp capacity

Here's an entirely new Allis-Chalmers concept in cast iron adjustable sheave design. It's the newest member of the *Texrope* drive family, the *Magi-Key* sheave!

This new sheave makes it really easy and inexpensive to obtain variable speeds on low-horsepower applications. Here's why:

✓ Handles design horsepower applications from fractional to 13 hp.

✓ Features positive locking between sheave and shaft.

✓ Has combination keylock from disc to hub . . . no more fumbling to get proper tightening.

✓ All rotational torque transmitted through keys.

✓ Key lock won't slip — setscrew can't fly out.

Magi-Key sheaves are available in one and two-groove sizes for either A or B section V-belts. Find out more from your A-C district office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

HERE'S THE KEY. This combination keylock from disc to hub makes adjustment easy.

Texrope and *Magi-Key* are Allis-Chalmers trademarks.

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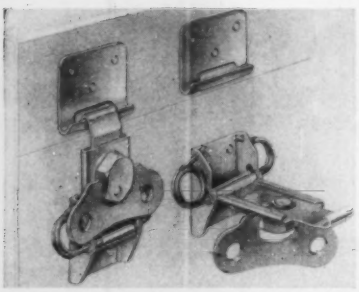
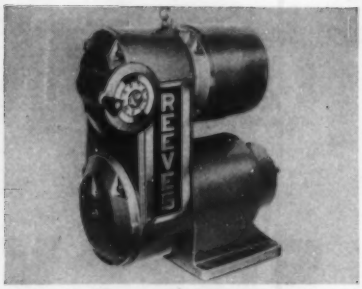


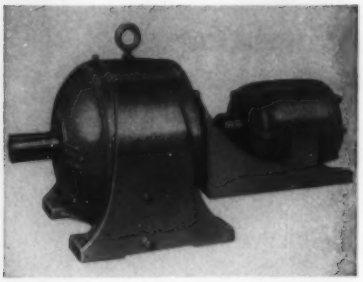
Link-Lok spring-loaded fastener provides compensation for gasket and surface irregularities. Simmons Fasteners Corp., N. Broadway, Albany 1, N. Y.

Circle 801 on page 19



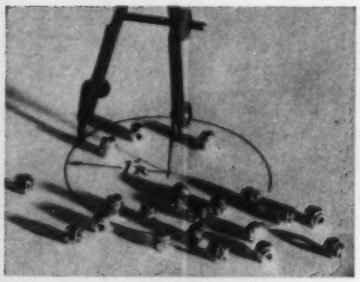
Reeves Vari-Speed Motodrive is available to 5 hp. Remote controls are available. Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, O.

Circle 802 on page 19



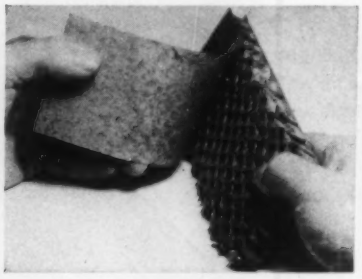
Motorized gear reducer accommodates wide range of motor sizes by changing bracket. Ratings are 1 to 75 hp. Louis Allis Co., 455 E. Stewart St., Milwaukee 1, Wis.

Circle 803 on page 19



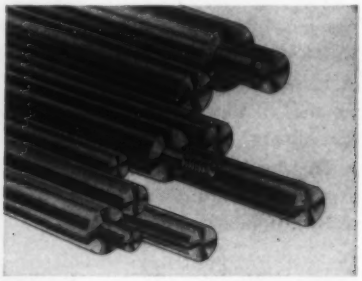
Miniature self-locking clinch nuts are for blind mounting of small components on thin-wall panels. Standard Pressed Steel Co., Jenkintown, Pa.

Circle 804 on page 19



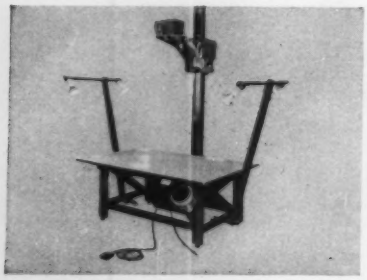
Elastomeric adhesive bonds a wide variety of materials. Minnesota Mining and Mfg. Co., Adhesives and Coatings Div., 411 Piquette Ave., Detroit 2, Mich.

Circle 805 on page 19



Bar stock, called 60 Case, is AISI 1060 steel with surface hardness of Rockwell C 60. Size is ¼ to 4 in. diam, lengths to 14 ft. Thomson Industries Inc., Manhasset, N. Y.

Circle 806 on page 19

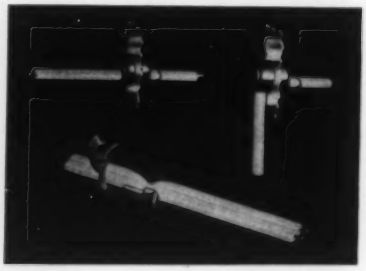


Microfilming planetary camera uses 35-mm film. Reductions are 16:1 to 29:1. Sperry Rand Corp., Remington Rand Div., 315 Fourth Ave., New York 10, N. Y.

Circle 807 on page 19

Wedge-roll over-running clutch has maximum possible capacity for given diameter consistent with low resistance. Hilliard Corp., 98 West 4th St., Elmira, N. Y.

Circle 808 on page 19



Heyco nylon strain reliefs accommodate wire sizes from No. 18-2 to No. 14-3. Straight and angle units are available. Heyman Mfg. Co., 100 Michigan Ave., Kenilworth, N. J.

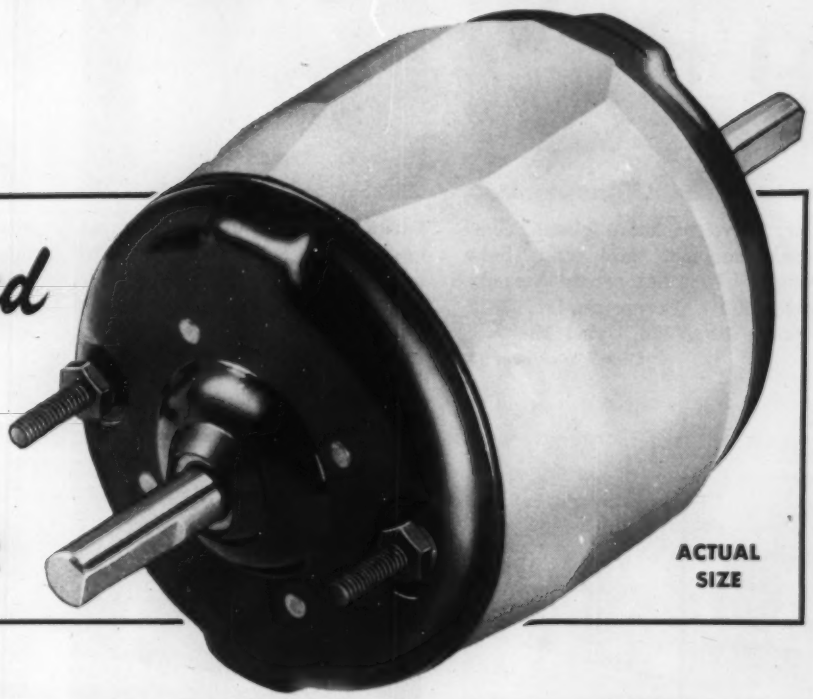
Circle 809 on page 19

MORE HORSEPOWER . . .

in an Economical, Compact, Quality Package

Redmond

Series
Type
MICROMOTOR



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The Redmond type TW series MicroMotor is an especially designed actuator motor—not a modified heater motor of conventional stamped steel construction. The stator core is precision die cast to make a rigid, durable motor. The exact bearing alignment and uniformity of air gap result in a motor that will give you years of trouble-free service and quiet operation.

The TW series motor is available with 6 volt DC to 115 volt AC or DC performance winding. The horsepower range is 1/150 to ¾, depending on the speed and type of duty required.

This motor is ideal for pumps, can openers, chair vibrators and actuators, blowers, hedge trimmers, and tape dispensers. Typical automotive applications are window and seat actuators, top lifts, evaporative coolers, and air-ride compressors.

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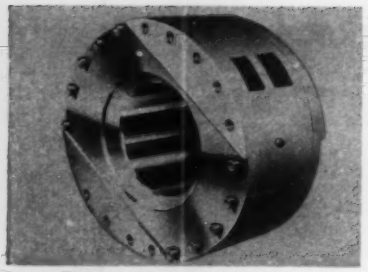
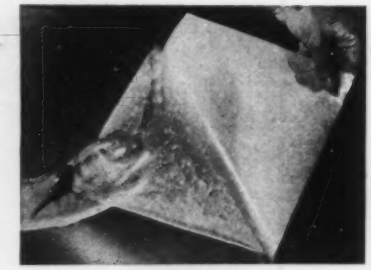
Circle 498 on page 19



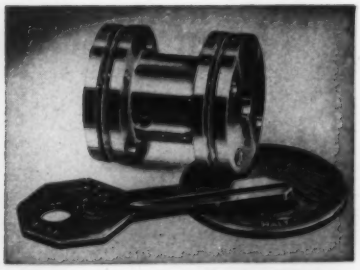
Large-bore backstop clutch combines compact size and light weight. Unit has torque capacity to 136,500 lb. Formsprag Co., 23617 Hoover Rd., Van Dyke, Mich.

Circle 810 on page 19



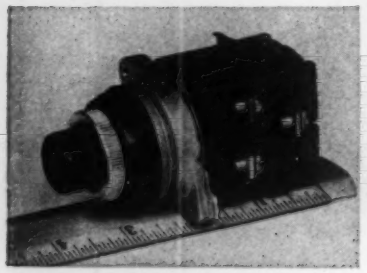
Tackmaster pressure-sensitive adhesive is a solid film with two tacky sides for bonding plastic. Rubber & Asbestos Corp., 225 Bellevue Ave., Bloomfield, N. J.

Circle 811 on page 19



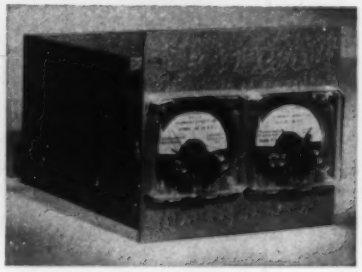
Miniature coupling for power transmission is available in three sizes. Capacities to 60-lb-in. Thomas Flexible Coupling Co., Main Ave. and Biddle St., Warren, Pa.

Circle 812 on page 19



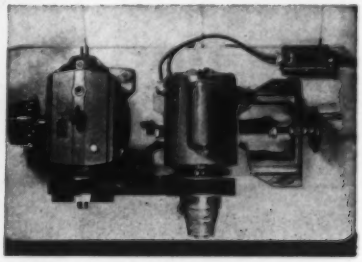
Oil-tight push button unit has indicating light with any of six different color caps. General Electric Co., 1 River Rd., Schenectady 5, N. Y.

Circle 813 on page 19



Three-position controller with instantaneous action corrects the signal to a specific point within a preset range. Assembly Products Inc., Wilson Mills Rd., Chesterland, O.

Circle 814 on page 19



Variable-speed drive maintains constant driven-shaft torque through 3:1 speed variation. Models range to ¾-hp capacity. Boston Gear Works, 3200 Main St., Quincy, Mass.

Circle 815 on page 19

Duran Clad is a semirigid vinyl sheeting for laminating to steel and nonferrous metals in flat sheets or continuous coils. It can be shaped or formed with the metal. Bond is unimpaired by forming. A wide variety of colors and textures is available. Masland Duraleather Co., Industrial Products Div., Amber St., Philadelphia 34, Pa.

Circle 816 on page 19

High-strength expansible compounds insulate and reinforce voids between structural members. Thermosetting, self-curing polyisocyanate foams are two-part liquid formulations that will foam in place to fill cell voids. Minnesota Mining and Mfg. Co., Adhesives and Coatings Div., 411 Piquette Ave., Detroit, Mich.

Circle 817 on page 19

Ano-Coil is color-anodized aluminum strip in coils. Material permits continuous automatic feeding for roll-forming or stamping operations. Gold and brass finishes and colors are available. Typical applications are nameplates, weatherstripping, and trim. Fromson Orban Co. Inc., 261 Madison Ave., New York 16, N. Y.

Circle 818 on page 19

Expansion joint eliminates bellows; blowout possibility is removed. No packing is required and no friction loads are imposed on anchors. Seal is Teflon wedge. Size range is ½ to 6 in.; total travel is 2 in. for all sizes. Maximum working pressure is 500 psig; temperature is 500 F max. Rotherm Engineering Co., 7280 Devon Ave., Chicago 31, Ill.

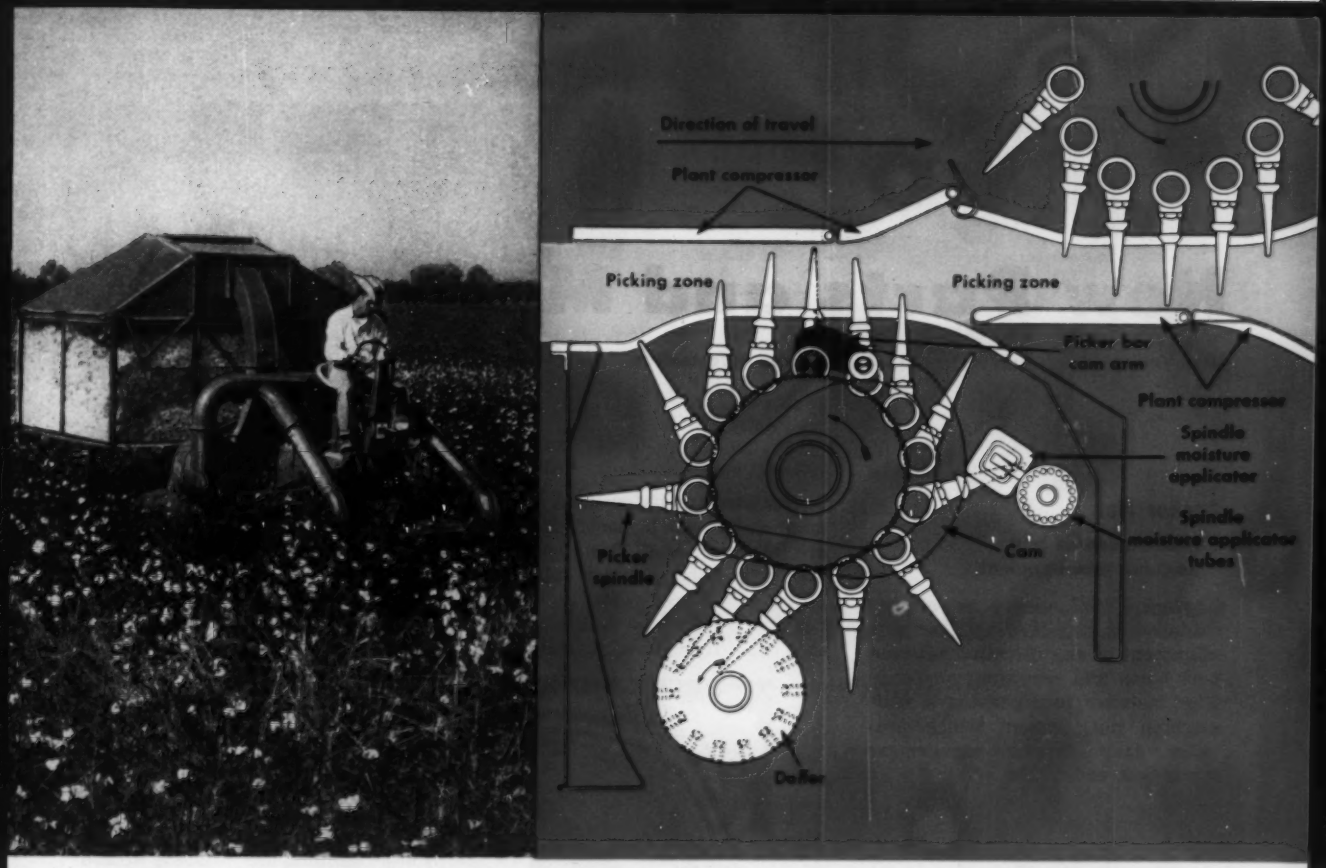
Circle 819 on page 19

High - temperature insulation, T-0278, is an organic modified-silicone approaching heat-resistance requirements of Class H silicone materials and with extremely good solvent resistance. Material is flexible straight-weave continuous-filament glass fabric. Westinghouse Electric Corp., Micarta Div., Trafford, Pa.

Circle 820 on page 19

Film-type electrical heating elements in sheet form are of 0.004-in. glass cloth, refined graphite, and an inorganic binder. Heating film is on one side and is unaffected by water or solvents. Weight is less than 1 oz per sq ft. Heat is developed evenly over desired surface at up to 60 w per sq in. Electrical Coatings Inc., Beverly, Mass.

Circle 821 on page 19



How angular power transmission makes still another improved design practical

This cotton picking machine is just one of many, many products improved and made more practical through the flexibility of angular power transmission.

Using the angle of transmission shown at right, the makers of the machine can put a whole row of spindles on a bar and drive them with a single source. The spindles pluck bolls gently from the cotton plant and deliver them unmarred to a collecting basket.

Besides this flexibility, bevel gear transmissions usually weigh less, cost less, and carry heavier loads.

Our engineers are ready at all times to help you work out applications for bevel and hypoid gears.

They can discuss such items as mountings and lubrication. They can produce and test prototypes of your drives.

Finally, they can advise you on the proper machinery to use to produce top quality gears in large quantities at low costs.

Please write whenever you have an application in mind.

Meanwhile, you'll find these Gleason Technical Handbooks helpful:

20° straight bevel gear system
Spiral bevel gear system
Zerol® bevel system

The cotton picking machine shown above, uses 420 of these tapered spindles in its picking drum (diagram). The machine slashes picking costs by as much as 60%.

GLEASON WORKS

Builders of bevel gear machinery for over 90 years

1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.

Circle 499 on page 19

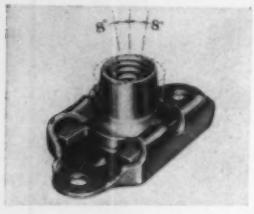
New Parts and Materials

Use Yellow Card, page 19, to obtain more information

Anchor Nut

accommodates bolt angular misalignment

Kaylock F1967 anchor nut accommodates up to 8 deg angular misalignment in any direction between bolt holes and mounting surfaces. The fastener incorporates a self-aligning nut element which provides easy thread engagement when bolt enters the nut. Ample



float allows for tolerance build-up in the structure. Nut is adaptable for aircraft structures such as tapered spars, tapered skins or die-fabricated parts with draft angles. Of all-metal construction, it conforms to applicable military specifications, and is for use in temperatures up to 550 F. Unit is available in ¼-in. tap size. **Kaynar Co.,** Kaylock Div., Box 2001, Terminal Annex, Los Angeles 54, Calif.

Circle 822 on page 19

Transistorized Circuits

for plug-in assembly of digital systems

M-Pacs, transistorized logical circuits for asynchronous digital computing, data handling, logical analysis, simulation, and control systems, are designed for dc operation in the zero to 100-kc range. They can be combined to perform all digital operations including arithmetic computation, storage, programming and logical decision. Operations are determined by the manner in which basic packages are interconnected. Basic packages are: Flip-flops, emitter followers, pulse amplifiers, diode gates and buffers, inverter amplifiers, one-shot multivibrators, variable-fre-

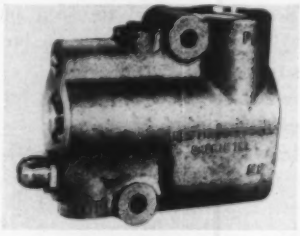
quency blocking oscillators, and crystal-controlled square-wave oscillators. Each M-Pac circuit is contained on a 2½ x 3¼-in. epoxy-glass printed-circuit card. **Computer Control Co., Inc.,** 92 Broad St., Wellesley 57, Mass.

Circle 823 on page 19

Flow Divider

controls high pressures in large equipment

Model 1088 flow divider meets the requirements of large equipment needing better control of higher



pressures. It has an adjustment device which decreases or increases proportion between flow on the controlled-flow side to the rate of flow in main circuit. Built-in relief valve bypasses oil back to the sump when peak pressure setting of the secondary flow is reached. Unit permits two simultaneous operations from one pump and divides flow in any proportion. It operates on low circulation pressure from the pump and is reliable with any fluid at any temperature. **New Products Corp.,** 3636 Oakton St., Skokie, Ill.

Circle 824 on page 19

Flushed Etched Circuits

for printed wiring use

These circuits are printed, etched and flushed into an epoxy-glass laminate. After they are flushed, they remain stable and do not creep above the surface of the laminate. They resist shock, vibration and abrasion, and exhibit

excellent heat resistance under conditions encountered in dip, roll and hand soldering. Circuits produced by this process can be used for commutators, rotary timing disks and any other applications where reliability and flush surface are required. **Mica Corp.,** 4031 Elenda St., Culver City, Calif.

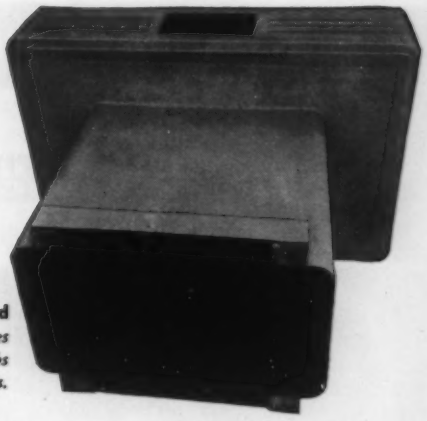
Circle 825 on page 19

Solenoid Pilots

handle air, vacuum, oil, water and inert gases

Continuous internal cooling of the solenoid coil and self-cleaning effect of actuating plunger prevents overheating and assures long,

Original design *requires ½" sections, weighs 896 pounds.*



Present welded steel design *uses ¼" sections, weighs only 446 pounds.*

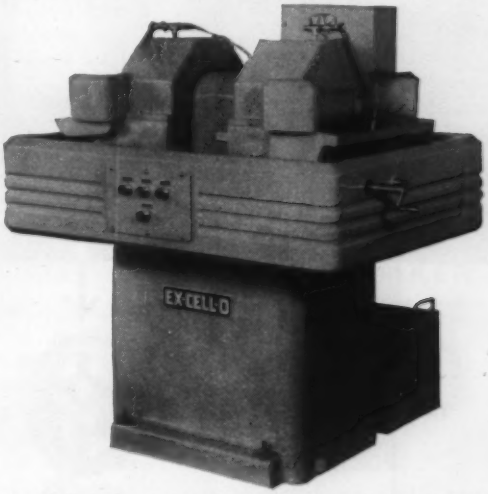
DESIGNED FOR GREATER RIGIDITY

. . . welded steel makes it better—at lower cost

THIS machine tool base was once a casting, but is now fabricated by welding. The result . . . still higher quality, more rigid machine.

Because of steel's greater strength, the required rigidity is attained with half the weight of casting. Manufacture is simplified, pattern expense is eliminated, lowering production costs.

These benefits can be duplicated on many types of machine components similar to your own through proper design for welded steel. A Lincoln specialist will gladly show you how.



Welded steel *tool grinder for sharpening single point tools of carbide, cast alloys and high speed steels. Photo courtesy Ex-Cell-O Corporation, Detroit, Michigan.*

THE LINCOLN ELECTRIC COMPANY

Dept. 1122, Cleveland 17, Ohio

Creating lower costs for industry . . . with welded design

When steel is 3 times stronger than iron . . .

Has two and one-half times the rigidity . . .

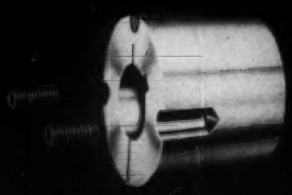
Yet costs a third as much per pound . . .

WHY

aren't your products designed for welded steel.

IT'S **TAPER-LOCK**

—IT'S INTERCHANGEABLE!



TAPER-LOCK SHEAVES

TAPER-LOCK SPROCKETS

TAPER-LOCK COUPLINGS
Rigid—Flexible—Chain

TAPER-LOCK STEEL CONVEYOR PULLEYS

The New Way to Cut Costs

Save time in mounting. Cut down-time on production machines. Standardize with Taper-Lock, the *interchangeable* bushing. The same Taper-Lock bushing fits sheaves, sprockets, couplings, conveyor pulleys. That means smaller inventories of power transmission parts. And it means quicker changes when necessary to keep production lines running!

Taper-Lock bushings are available in a range of sizes which makes it easy to change from one size shaft to another. Taper-Lock products slip onto the shaft quickly — hold with the firmness of a shrunk-on fit—come off easily, without shock to bearings or machinery. You'll profit by standardizing on Taper-Lock.

DODGE MANUFACTURING CORPORATION
3300 Union Street **Mishawaka, Indiana**

DODGE
of Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on new methods. Look for his name under "Power Transmission Machinery" in the yellow pages of your classified telephone directory — or write us.

trouble-free service in new Speed King solenoid pilots. The units, capable of handling air, vacuum, oil, water and inert gases, for direct, sub-base or manifold mounting, are available in two and three-way types for separate pilot control applications. They are also used on single and double-solenoid pilot-operated control valves. Solenoid coils are supplied for 3 to 300 v dc and 6 to 550 v ac, 25 to 60 cycles. Coil current consumption at 115 v, 60 cycles, is 0.2 amp. **Valvair Corp.**, 454 Morgan Ave., Akron 11, O.

Circle 826 on page 19

Plastic Knobs

include military types

Four new plastic knobs and one redesigned type are available with slotted or socket-type setscrews and many other types of mountings. Three knobs, available in various colors, are for general commercial use. One knob meets MIL-P-14 military specifications per drawing MS 90120-2B01. Another knob has been redesigned to meet military specifications by equipping it with metal insert for ¼-in. diameter shaft. **Rogan Brothers,** 8003 N. Monticello Ave., Skokie, Ill.

Circle 827 on page 19

Synthetic Rubber Enamel

withstands continuous temperatures to 250 F

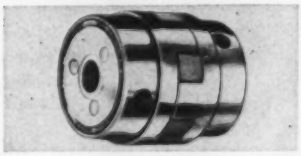
Pliogard, used for protecting finish on hydraulically operated equipment, is a high solids, synthetic-rubber coating made from styrene butadiene resins. Dustfree, it air dries in 30 minutes to a tough, adherent, chemical-resistant film on metal, wood and concrete. Application can be made by spray, brush, dip or roller, and no primer is necessary. Coverage is 500 sq ft per gal to a dry-film thickness of 1.5 mil. A thermoplastic, non-oxidizing coating, the enamel withstands continuous temperatures to 250 F. It is available in 14 standard colors or to specification. **Saran Protective Coatings Co.,** 2415 Burdette Ave., Ferndale 20, Mich.

Circle 828 on page 19

Flexible Coupling

is rated 0.4 hp at 100 rpm to 4.6 hp at 3600 rpm

Type L-093 die-cast zinc flexible coupling is designed for low-cost original equipment installation. Coupling consists of two bodies with jaws and a one-piece spider-type cushion. Lubrication is not required, and dust, dirt, mud, water or other adverse conditions



have no effect on performance. Load is transmitted by cushion compression. Cushion can be reversed for double service life. Standard material is oil-resistant, high resilient Buna-N compound. Also available are: oak-tanned leather, Bakelite, and Bakelite with Buna-N center. Ratings range from 0.4 hp at 100 rpm to 4.6 hp at 3600 rpm. Overall length of the unit is 2½ in. **Lovejoy Flexible Coupling Co.,** 4882 W. Lake St., Chicago 44, Ill.

Circle 829 on page 19

Phase-Voltage Converter

converts single-phase to three-phase current

Phase-voltage unit converts single-phase, 115-v, 60-cycle alternating current to three-phase, 230-v, 60-cycle current. Frequency is held constant within a fraction of a cycle from no load to full load. Machine is rated at 500 w. It is

(*Continued on Page 214*)

FLEXIDYNE
THE DRY FLUID DRIVE
100% efficiency at full load!

DODGE-TIMKEN
America's Quality Pillow Blocks!

SEALED-LIFE V-BELTS
The life is sealed in!

Write for Bulletins!

- Flexidyne Dry Fluid Drives and Couplings. Bulletin A-640-A.
- Roller Bearings. Load ratings, dimensions, etc. Bulletin A-638.
- Sealed-Life V-Belts. Complete data and sizes. Bulletin A-606-A.

DODGE MANUFACTURING CORPORATION
3300 Union Street • Mishawaka, Indiana

DODGE
of Mishawaka, Ind.

Circle 502 on page 19

NOW! industrial hydraulic equipment from

WOOSTER DIVISION

Wooster Division now occupies this modern 104,000-sq. ft. plant in the heart of the mushrooming automotive and agricultural equipment industries. It is completely equipped for engineering, development, production and servicing of Wooster products.

Growth has led to the establishment of the Industrial Division of Pesco Products as a separate Borg-Warner facility—the Wooster Division.

This division will specialize in hydraulic pumps, motors, power packages and other accessories for *industry*—automotive, earthmoving, agricultural, material handling.

Here's how this will benefit users of industrial hydraulic equipment:

- **high product quality**—long associated with Pesco—will be assured from Wooster. Pesco "know how" plus a complete staff of experienced engineering, sales and production personnel has been installed at Wooster.
- **improved deliveries** from increased manufacturing facilities devoted exclusively to *industrial hydraulic equipment*.
- **better service** through close personal attention to customer requirements will be a Wooster operating policy.
- **advanced designs**—the result of extensive research facilities and development programs—will be a Wooster forte, in the Pesco tradition.

For detailed information or engineering assistance in applying Wooster hydraulic equipment to your products, contact the sales office nearest you or the main office.

WOOSTER PRODUCTS:

Hydraulic pumps • Hydraulic motors • Hydraulic power packages • Relief and control valves

WOOSTER SALES OFFICES:

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WOOSTER DIVISION • BORG-WARNER CORPORATION
Old Mansfield Road • Wooster, Ohio

BORG-WARNER

aircraft accessories from

PESCO PRODUCTS DIVISION

Pesco plant, "home of the aircraft fuel pump", is strategically located in a Cleveland suburb. Its 312,631-sq. ft. contain outstanding facilities for development engineering and aircraft-precision production.

Pesco—with an outstanding record as a leading supplier to the aircraft industry—now takes a forward step to improve and expand services to its customers.

All Pesco facilities are now being concentrated on the engineering and production of hydraulic and fuel accessories for military craft, commercial airliners, rockets and guided missiles.

Thus, the aircraft industry can now look with confidence to Pesco for—

- **better deliveries**—the result of increased manufacturing capacity.
- **accelerated engineering development** of new concepts of pressurized fluid flow for tomorrow's aircraft.
- **dependable products** designed for superior performance and utmost reliability.
- **a continual expansion** of facilities and services to keep pace with the aircraft industry which it serves.

You will agree, we think, that now—more than ever before—*Pesco means progress in pumps.*

PESCO PRODUCTS:

Fuel pumps • Fuel booster pumps
Hydraulic pumps • Hydraulic motors
Hydraulic power packages • Air pumps
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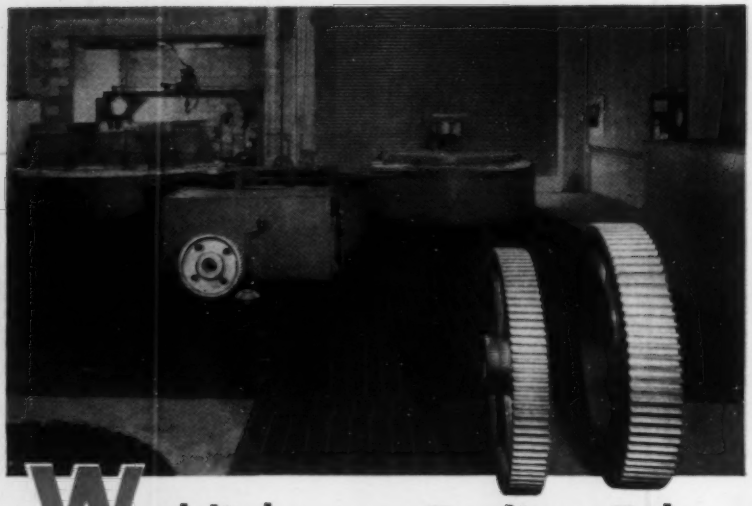
CORPORATION

Circle 503 on page 19



World's largest Radiant Tube Pit-type Carburizer installed at BRAD FOOTE

...more precise heat treatment for larger gears

• New heat-treating equipment, including the largest radiant tube pit-type gas carburizing furnace ever built, has recently been installed in the Pittsburgh plant of our subsidiary, Pittsburgh Gear Company. These new additions to BRAD FOOTE's extensive heat-treating equipment provide facilities for the most advanced techniques in deep case carburizing and hardening in controlled atmospheres.

• The new carburizer can handle gears or machine parts up to 6 feet long, 6 feet wide and up to 8500 pounds in weight. In addition to its size, the new equipment has an unusual ability to control carbon penetration, giving extremely precise control of the depth of surface hardening.

• Special heat-treating equipment, like this new carburizer, allows BRAD FOOTE to impart the precise metallurgical characteristics which make for longer wear, shock resistance and freedom from distortion in gears of all sizes and types. And BRAD FOOTE heat-treating is under the supervision of metallurgists with long experience in the special problems of the gear industry.

• Whether you want one gear or ten thousand, BRAD FOOTE's extensive facilities and specialized skills are at your disposal. Send us the specification on your next problem job for quotation. No obligation, of course.

BRAD FOOTE MAKES
Spur • Bevel
Helical • Spiral Bevel
Herringbone
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subsidiaries
AMERICAN GEAR & MFG. CO. Phone: Lemont 920 Lemont, Illinois
PITTSBURGH GEAR COMPANY Phone: SPalding 1-4600 Pittsburgh 25, Pennsylvania

New Parts

(*Continued from Page 211*)

8½ in. wide, 9 in. high and 10 in. long. Relay starting switch, starting capacitor and input and output receptacles can be mounted in a small box on the converter, at a

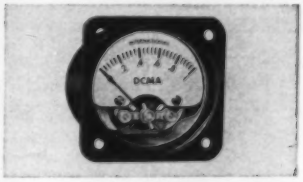
separate station, or within a housing that eliminates all operating noise. Intake and exhaust air vents are located in bottom halves of endbells, making unit dripproof. **Kato Engineering Co.**, 1415 First Ave., Mankato, Minn.

Circle 830 on page 19

Miniature Panel Meter

for edge-light panels

This 1½-in. square panel meter, designated Model 155, is designed for mounting on edge-lighted panels. It is provided for front mounting with minimum projection. Meter incorporates a miniaturized



D'Arsonval-type movement which combines small size and light weight with high sensitivity. Accuracy is held to ±3 per cent of full scale deflection for dc installations and ±5 per cent for ac. A watertight construction is available which meets MIL-M-3823. **International Instruments Inc.**, P. O. Box 2954, New Haven 15, Conn.

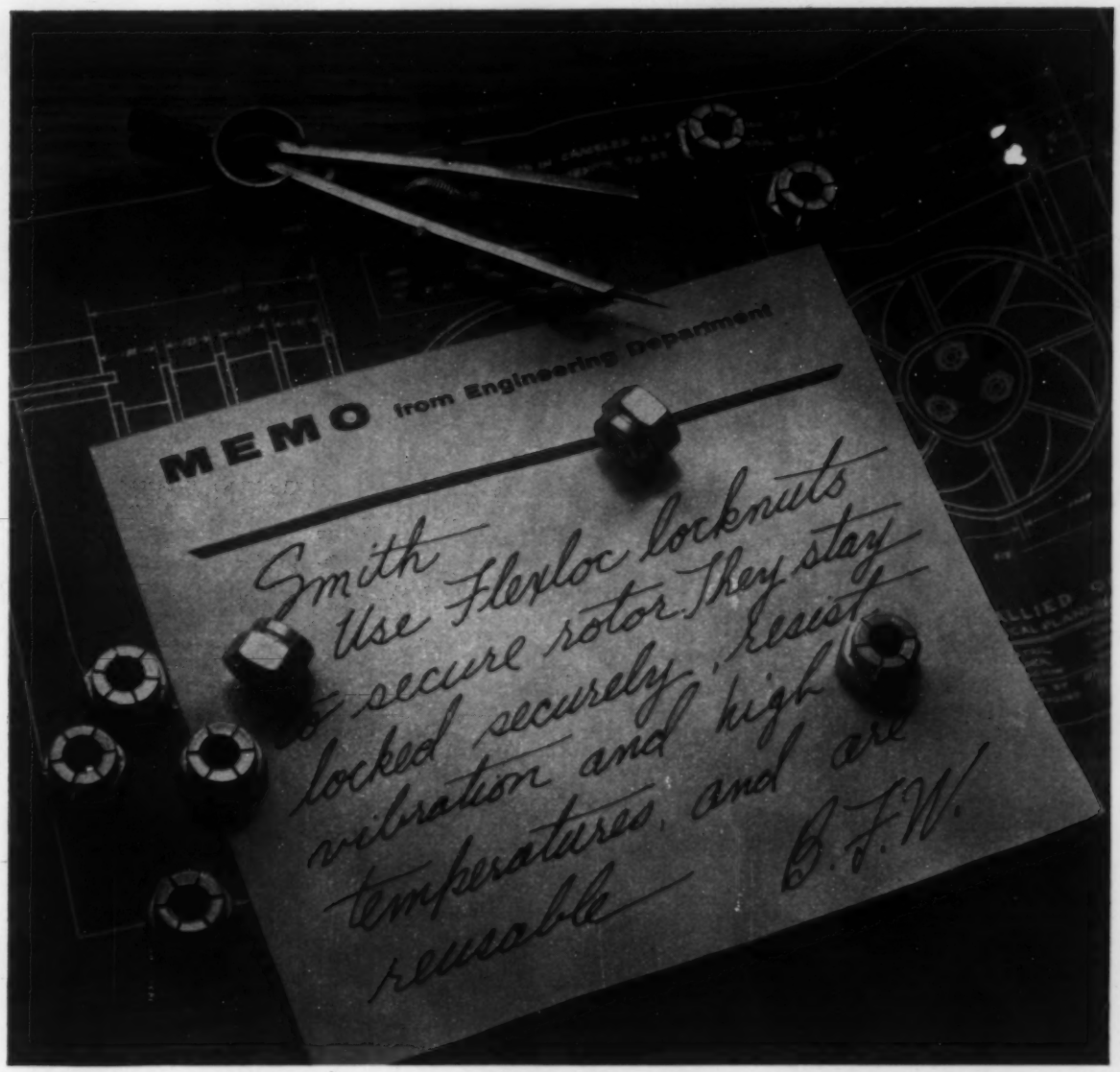
Circle 831 on page 19

Engine-Oil Cooler

for applications to 400 Btu per minute

Plate-type engine oil cooler, in varying two to eight-plate arrangements, is designed for use on or in any engine requiring lubricant

Circle 504 on page 19



Vibration won't loosen FLEXLOC self-locking nuts

Where products must be reliable . . . must stand up under vibration, temperature extremes and hard use . . . designers specify rugged, reliable, precision-built FLEXLOC self-locking nuts.

HERE'S WHY:

FLEXLOC locknuts are strong: tensile strengths far exceed accepted standards. They are uniform: carefully manufactured to assure accurate, lasting locking action. And they are reusable: repeated removal and replacement, frequent adjustments, even rough screw threads will not affect their locking life.

Standard FLEXLOC self-locking locknuts are available in a wide range of standard sizes, types and materials to meet the most critical locknut requirements. Your local industrial distributor stocks them. Write us for complete catalog and technical data. Flexloc Locknut Division, STANDARD PRESSED STEEL CO., Jenkintown 18, Pa.

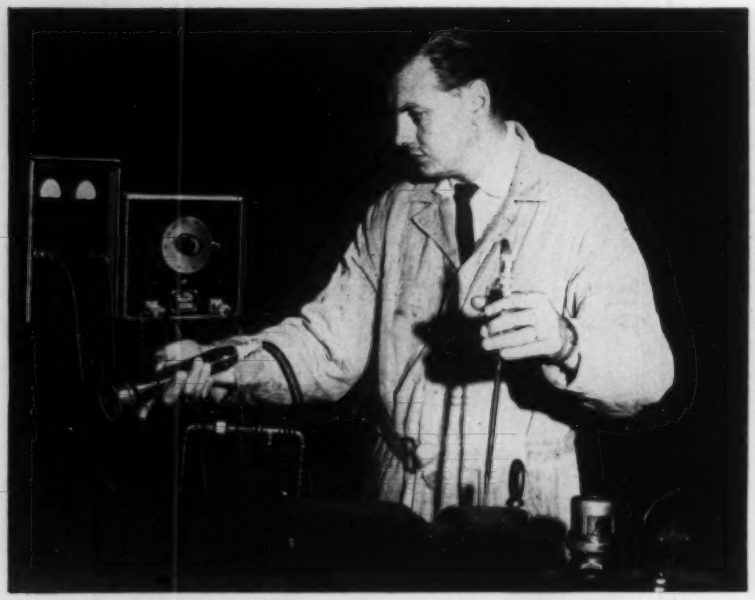
FLEXLOC® LOCKNUT DIVISION

STANDARD PRESSED STEEL CO.

SPS

JENKINTOWN PENNSYLVANIA

Circle 506 on page 19



"MACHINERY ANALYZER saves us $1000 per hour..."

"We've had total savings of more than $100,000 since we purchased the analyzer three years ago. The analyzer has been shipped over 100,000 miles by air, rail, and car to our eight plants without need for repairs or replacements" — reports a leading chemical processor.

The Machinery Analyzer — actually a portable IRD Vibration Analyzer — is used for . . .

- TROUBLE-SHOOTING — to pinpoint faulty components exciting vibration *without costly dismantling.*
- MEASURING DISPLACEMENT — to accurately determine the condition of machinery *without costly dismantling.*
- IN-PLACE BALANCING — to dynamically balance at operating speed the accessible rotating components *without costly dismantling.*

Here are several examples cited by company officials:

- Detecting a broken gear in an important gear reducer saved a major loss of production.
- Savings of $2000 in balancing a ringer assembly because dismantling and loss of production were eliminated.
- A 450 HP motor was balanced, in place, at savings of $8000 to $10,000 in production and maintenance costs.

What portable IRD Vibration Analyzers are doing for this company — to reduce inspection, maintenance, and production costs — it can do for your company.

IRD

For further information — or an actual demonstration on your own machinery by an IRD field engineer — write today to International Research and Development Corporation 797-MD Thomas Lane, Columbus 16, Ohio.

New Parts

cooling. Applications extend to 400 Btu per minute. It can be applied to any type of oil cooling, such as in transmissions, torque converters and hydraulic presses. Housing is manufactured from steel stampings. Exterior is painted; waterside is clad with rust and

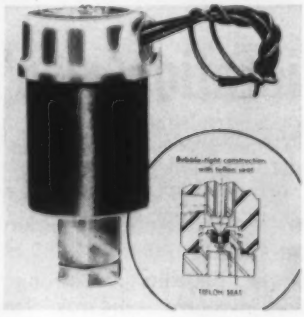
corrosion - resistant cupronickel. Mutiple-plate core assembly can be removed from housing without disturbing water connections. Diagonal flow path of oil provides maximum efficiency of cooling element. Cooler can be attached to the engine as an accessory or built into the block. **Borg-Warner Corp.,** Long Mfg. Div., 12501 Dequindre St., Detroit 12, Mich.

Circle 832 on page 19

Solenoid Valve

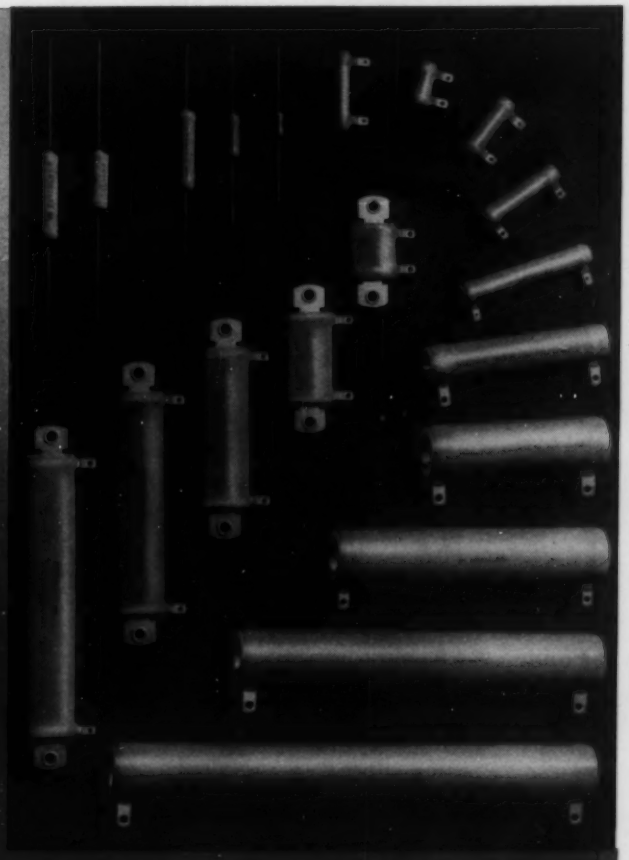
is bubbletight at 5000 psi

Type SBTDW solenoid valve is a small, direct-lift, stainless-steel, angle type. Teflon seat eliminates metal-to-metal seal and assures bubbletight operation to 5000 psi



with helium, nitrogen and carbon dioxide. It can be used over a wide temperature range for applications where high pressure is combined with relatively little flow. Direct lift action provides instantaneous opening and closing even with viscous fluids. Pipe sizes are ⅛

Now! Vitrohm MIL-R-26C Resistors in all styles!



Famous Ward Leonard Vitrohm® vitreous-enameled resistors are now available in every style to meet all requirements of Military Specification MIL-R-26C including the severe bogeys on moisture resistance, thermal shock, insulation resistance and many other properties.

What's more, this line offers you *all* characteristics—G, V, and the exacting Y—and *all* specification sizes and resistance values—even the highest values using the finest wire (0.00175" dia.) permitted by the spec.

Tab-terminal, axial-lead and stack-mounting types are available in styles and characteristics shown in table.

For complete data on these MIL-R-26C resistors, write us for Bulletin 12. (And incidentally, for Vitrohm resistors to *highest commercial and industrial standards*, get W/L Catalog 15.) Ward Leonard Electric Co., 58 South Street, Mount Vernon, N.Y. In Canada: Ward Leonard of Canada Ltd., Toronto.

ENGINEERING DATA

TYPE	STYLE	AVAILABLE IN CHARACTERISTICS	RESISTANCE RANGE
Stack Mtg.—Tab	RW20 thru 24	G	All values in Spec.
Tab terminal	RW29 thru 47	V, Y* and G	All values in Spec.
Axial lead	RW55 thru 59	V and G	All values in Spec.†

*Characteristic Y applies to styles RW30, 33, 37 and 47 only. Characteristic Y is similar to V but requires high insulation resistance at end of moisture-resistance tests.

†Maximum values for single-layer-wound resistors with 0.00175" diameter wire.

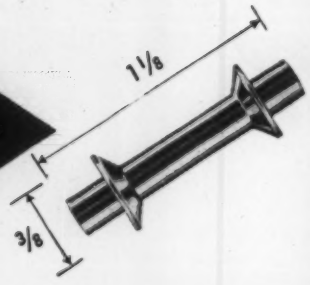
LIVE BETTER...*Electrically*

7.7

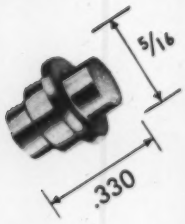
WARD LEONARD ELECTRIC COMPANY
MOUNT VERNON, NEW YORK

Relay-Engineered Control Since 1892

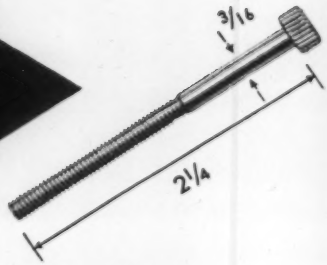
SAVINGS
$4.25
PER THOUSAND
over machine method cost



SAVINGS
$12.35
PER THOUSAND
over machine method cost



SAVINGS
$6.80
PER THOUSAND
over machine method cost



COLD-HEADING

SAVES YOU MONEY ON JOB-DESIGNED SMALL PARTS AND FASTENERS

Cold-Heading is the most versatile, most economical method for producing your fasteners and small parts. These case histories are typical of thousands of money saving jobs we've done for our customers. May we quote on your requirements? Write today for the Hassall Catalog.

John Hassall, Inc., P.O. Box 2197, Westbury, Long Island, N.Y.

Hassall

SINCE 1850

NAILS, RIVETS, SCREWS
AND OTHER COLD-HEADED
FASTENERS AND SPECIALTIES

New Parts

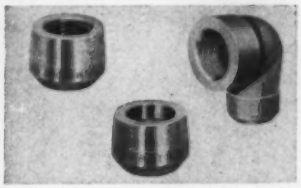
and ¼-in., with 1/16, 3/32, ⅛ or 3/16-in. port sizes. Coils are available in any voltage. **Atkomatic Valve Co. Inc.**, 545 W. Abbott St., Indianapolis 25, Ind.

Circle 833 on page 19

Outlet Fitting

for pipelines, tanks and pressure vessels

Couplet fitting functions as a universal outlet connection. It is used without modification on most tank, vessel and larger pipeline applications. Where attachment is to be made to a small diameter pipe, the



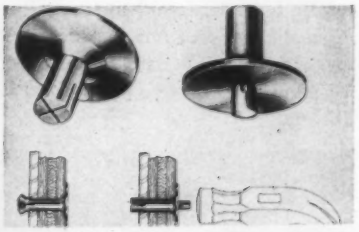
unit is modified by contouring the welding end to mate with curvature of pipe diameter. Units have extra length and heavier wall to permit contouring without detriment to strength of the fitting. Fittings are forged carbon steel in sizes ¼ through 2 in. with screw-end or socket-welding end connections; they are also available in 90-deg elbows. **H. K. Porter Co. Inc.**, W-S Fittings Div., P. O. Box 95, Roselle, N. J.

Circle 834 on page 19

Blind Drive Rivet

for installing plywood and composition board

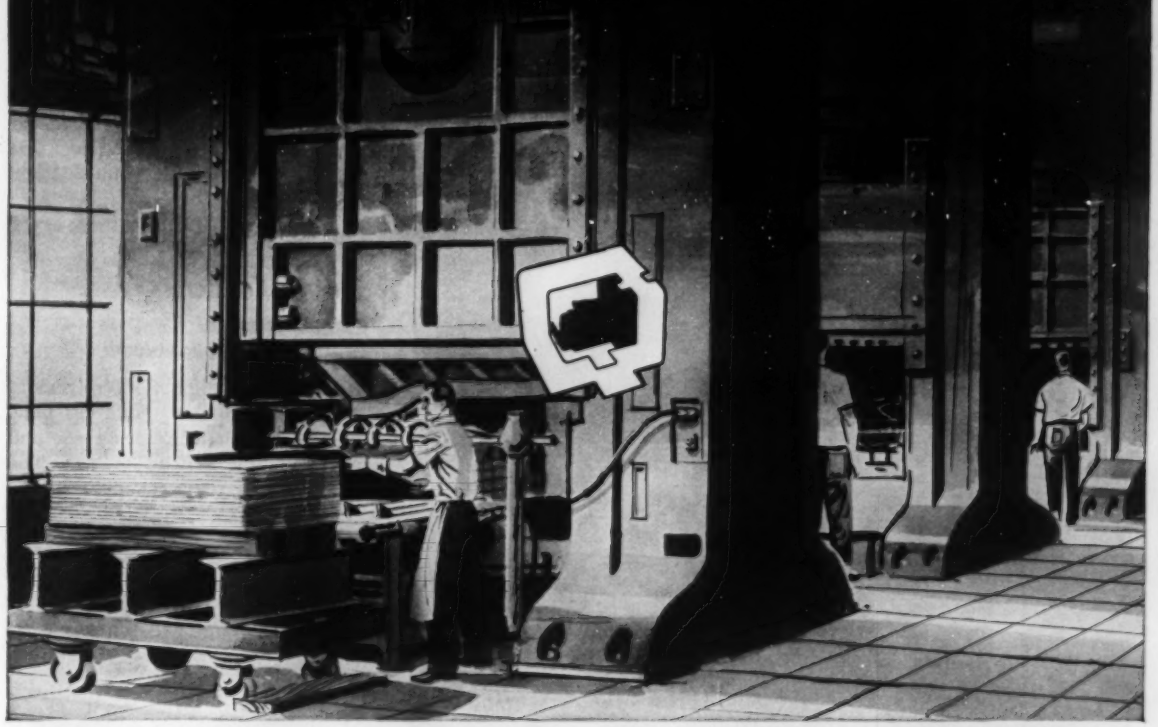
Ply-Head blind rivet provides an extra-large under-head bearing area, permitting higher loading



pressures without failure of board surface. Rivet is used for installing plywood and composition board in truck and trailer linings,

Circle 509 on page 19

Potter & Brumfield *engineering is in this picture*



MECHANICAL MONSTER OR MODERN MARVEL?

Select the P&B Relay which helps make the difference

AG Series
Enclosed Power Relay
Shock-Proof and Dust Proof

MW Series
Appliance Type Relay
with above Average
Performance and Life.

AB Series
Appliance Type Relay,
Heavy Duty Construction.

Proper controls turn monsters into marvels . . . and controls are only as good as their components, such as relays. Without controls, this massive press, or any automated equipment, becomes a nightmare of disorganized force.

P&B AG Series relays are particularly suited to automation. They are ruggedly constructed for excellent shock resistance, withstanding 100 G shock without mechanical damage. The AG is a tough relay designed for rough jobs.

A metal enclosure keeps out shop dust and dirt. The phenolic base meets all U/L requirements for spacing and creepage distances . . . and the DPDT contact arrangement permits a wide variety of circuit variations.

For over 25 years, P&B has been building relays, and modifying existing types, to suit specific applications. Write for new catalog or engineering consultation.

ENGINEERING DATA

SERIES: AG. Enclosed power relay for use in dusty or dirty applications.

CONTACTS: 3/16" dia. fine silver. Rated 5 amps., single break, 115 V. AC resistive. Rated 8 amps., double break, 115 V. AC resistive.

CONTACT ARRANGEMENTS: SPST NO-DM, SPST NC-DB, DPST-NO, DPST-NC, DPDT.

VOLTAGE RANGE: DC: 6 to 220 V. AC: 6 to 230 V.

COIL RESISTANCE: 30,000 ohm maximum.

POWER REQUIRED: 1.5 W. minimum DC at 25° ambient. 6 W. maximum.

AMBIENT TEMP. RANGE: —55° C. to +85° C.

TERMINALS: Screw type molded in phenolic base.

ENCLOSURE: Special dust cover.

DIMENSIONS: 2¾" L. x 2 11/32" W. x 3 5/32" H.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC, ELECTRICAL AND REFRIGERATION DISTRIBUTORS

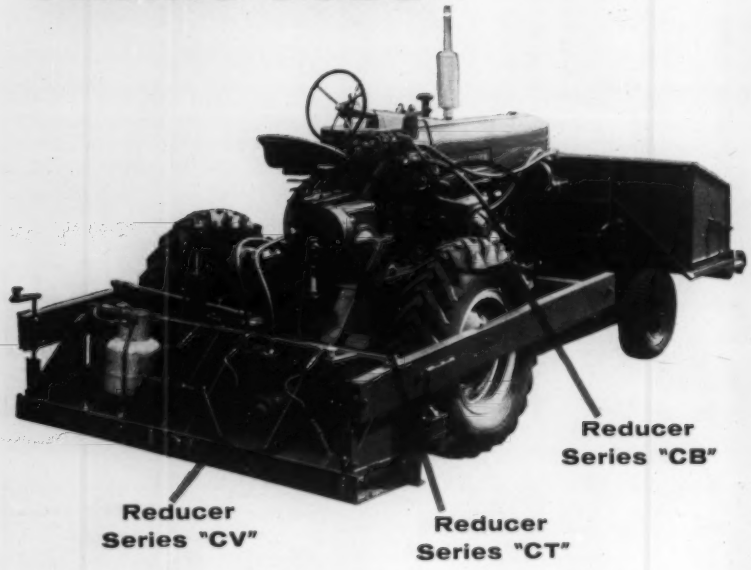
Potter & Brumfield, inc. **PRINCETON, INDIANA**

See our catalog in Sweet's Product Design File.

Subsidiary of AMERICAN MACHINE & FOUNDRY COMPANY **Manufacturing Divisions also in Franklin, Ky. and Laconia, N.H.**

3 WINSMITH SPEED REDUCERS

HELP TRAC-PAVER SMOOTH OUT ROUGH PAVING JOBS



Trac-Machinery Corp., manufacturers of TRAC-PAVER—the self propelled black top paver, select Winsmith Speed Reducers for three exacting control jobs.

Winsmith reducers were chosen for their ability to take plenty of on-the-job punishment—a requirement that TRAC-PAVER must meet every day on hundreds of jobs in the field.

On the TRAC-PAVER illustrated, a Winsmith reducer model 9 "CT" actuates the conveyor and auger; a 9 "CB" operates the traction drive and forward motion drive; and a 5 "CV" runs the finishing bar oscillating screed.

Whether your product uses one or many speed reducers per unit, investigate the advantages of standardizing on the Winsmith line...the most complete line within the range of 1/100 to 85 h.p.

WINSMITH SPEED REDUCERS

● Selection information and engineering data on the complete line is covered in Catalog #155. Write for your copy.

WINSMITH, INC. 16 Elton Street, Springville, (Erie County), N. Y.

New Parts

curtain walls, equipment cases and other applications. Unit is available in flat and ovaled-flat head styles, both heads having 5/8-in. diam and countersunk shoulder. Rivet shaft is 3/16-in. in diam, and six lengths accommodate nominal grips from 5/16 to 5/8-in. Body is aluminum and drive pin is stainless or cadmium-plated steel. **South Chester Corp.,** Southco Div., 3rd St. & N. Governor Printz Blvd., Lester, Pa.

Circle 835 on page 19

Impulse Counters

register up to 25 impulses per second

Four or five-digit Sodeco remote electrical impulse counters have manual pushbutton zero reset and are available for ac or dc. The units, which register up to 25 im-

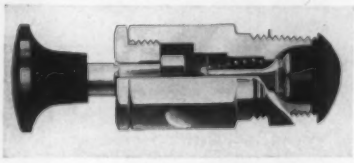
pulses per second, are designed for flush-panel mounting and are supplied with protective housing. Standard dc voltages are from 4 to 220; standard ac voltages are from 12 to 220. **Landis & Gyr Inc.,** 45 W. 45th St., New York 36, N. Y.

Circle 836 on page 19

Valves

for tank or fluid systems

Model P-646 valves for tank or fluid systems break vacuum automatically in draining and bleeding air displaced in filling. When fluid



is being withdrawn from the system or when temperature drops, valve opens automatically to break vacuum and permit free flow. Manual override permits holding

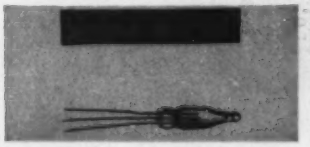
valve open to release entrapped air when system is being filled. O-ring design guarantees tight shut-off to hold tank pressure. Floating poppet design provides self-cleaning operation. Of lightweight aluminum, the valve is manufactured in ½ and ¾-in. pipe sizes. **Circle Seal Products Co. Inc.**, 2181 E. Foothill Blvd., Pasadena, Calif.

Circle 837 on page 19

Glow Lamp

is cold-cathode, three-wire type

NE-77 glow lamp, designed primarily as a switching device and for use in circuit-control systems, is a cold-cathode, three-wire type. When a voltage below that required for starting is held across outer electrodes, application of a sufficient voltage to center electrode circuit will cause lamp to start, passing current between outer electrodes. Lamp continues to pass current until a reverse voltage is applied to outer electrode circuit or until circuit is interrupted. Current is between 0.4 and 0.5 ma when lamp is conducting for long periods of time. If duration of current is very short, currents of up to 100 ma can be handled. **General Electric Co.**, Miniature Lamp Dept., Nela Park, Cleveland, O.



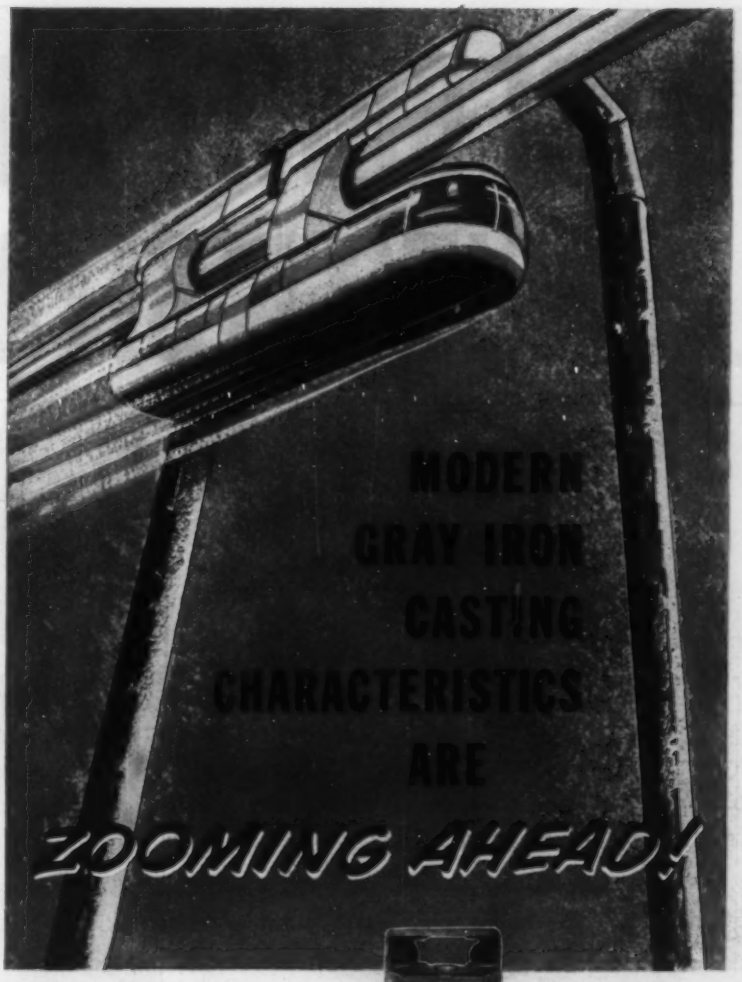
Circle 838 on page 19

Electrolytic Level Sensors

for missile directional systems

These small, arc-shaped gravity sensor devices are made for both off-on and proportional control in both vertical and lateral directions. When filled with electrolyte, they indicate level and deviation from level within tenths of a degree. Switches maintain optimum electrode-electrolyte contact throughout all flight maneuvers, thus are suitable for missile directional sys-

(*Continued on Page 224*)



This Gray Iron machine base saved 50% over fabricated steel design. It also improved the appearance and added desired performance factors.

With today's new ductile irons, users are buying iron castings under standard specifications with strengths more than 100,000 p.s.i.! Gray iron parts are also being used in structural applications under loads at temperatures up to 800°F. Learn how to make lower-cost products by utilizing the improved mechanical and physical properties of gray iron castings . . . *the most economical of all component parts.* Have at your fingertips the new Gray Iron Founders' Society Summary of Specifications, giving the latest properties of ductile and standard gray irons.

Free Summary of Specifications. Be sure you are fully acquainted with the new characteristics of gray iron. Ask your foundryman or write for a copy of GIFS up-to-date "Summary of Specifications".

it's time to design with

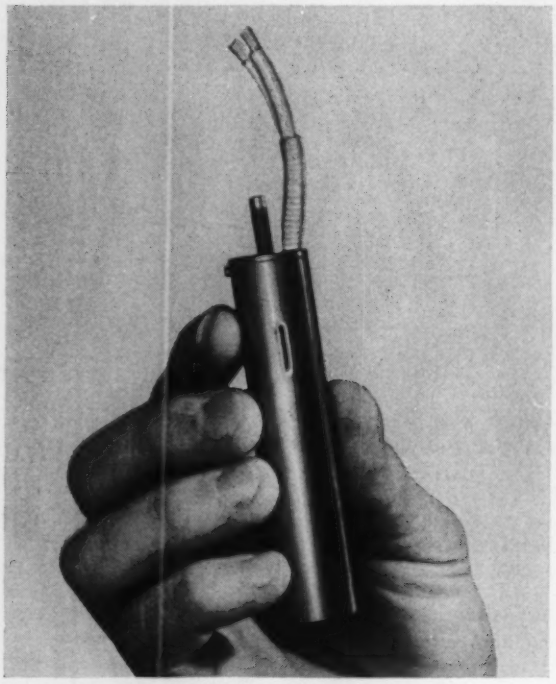
GRAY IRON CASTINGS

GRAY IRON FOUNDERS' SOCIETY, INC.
National City-East 6th Bldg. • Cleveland 14, Ohio

"Welcome to G.I.F.S. Booth #1242-44 at the Design Engineering Show"

Circle 512 on page 19

SEE WHY A FENWAL FITS ITS TASK AND

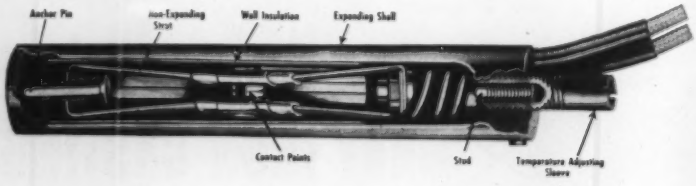


Standard Differential Expansion Units

are tough at the same time they are sensitive. They have these features in common: uniform sensitivity throughout the operating range . . . built-in temperature anticipation . . . enclosed, tamperproof assembly, direct radiant heat reception . . . operating range from −100° F to 600° F.

Midget and Miniature Differential Expansion Units

. . . some no larger than a sugar lump. Actual sizes ¼″ to 2 25/32″ for the Midget, and 1″ x ½″, Miniature. Ideal for "tight spots" where dependability cannot be sacrificed. Hermetically-sealed models. Midget temperature range −50° F to 500° F. Miniature −20° F to 275° F.



Here's How Differential Expansion Units Work . . .

the control element is a single-metal shell that expands or contracts instantaneously with temperature changes, making or breaking the totally-enclosed electrical contacts. The standard size, midget and miniature units all use this principle.

See us at the Design Engineering Show,

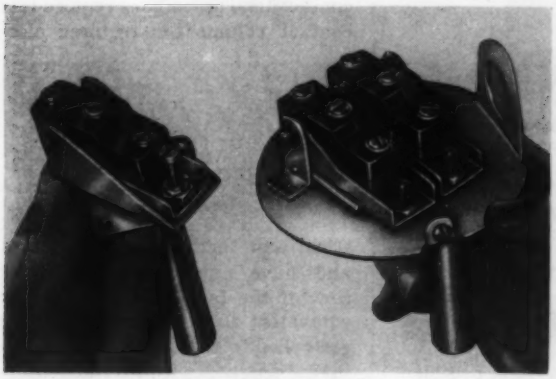
THERMOSWITCH® UNIT YOUR DESIGN SO WELL

Positive-Action Performance in Temperature Control Units in Many Sizes and Shapes

A better answer to many a temperature control situation is to be found on these pages.

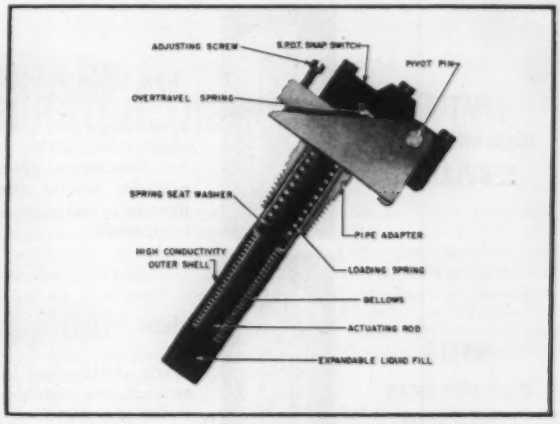
In fact Fenwal can furnish you with over 25,000 variations to satisfy your requirements of temperature range, precise control of set point, physical size and current carrying capacity.

Yes, Fenwal THERMOSWITCH units can provide the answer to your temperature control problems. The coupon will bring you the specific literature that will help you most. **Fenwal Incorporated, Ashland, Mass.**



Snap-Action Units

control loads up to 20 amps, 115-250 volts A.C., or 10 amps, 125 volts D.C. without relays. Picture shows only two of twelve basic models available from Fenwal's Series 20,000 (one switch) and Series 22,000 (two switch) snap-action units. Specialized units can be assembled for you from a selection of temperature ranges, headtypes and mounting styles.



Here's How Snap-Action Units Work . . .

the control action comes from an expandable liquid acting on a bellows assembly which actuates the switch contacts through a push rod. In Fenwal units, the liquid is outside the bellows, adjacent to the shell, for shorter heat transfer path and greater sensitivity.

Fenwal

CONTROLS TEMPERATURE

. . . PRECISELY

Fenwal Incorporated
196 Pleasant Street
Ashland, Mass.

Please send me literature and specifications on items checked.

- ☐ Fenwal Standard THERMOSWITCH units (MC-135A)
- ☐ Fenwal Midget and Miniature Controls (MC-124B)
- ☐ Fenwal Snap-Action Temperature Controls (MC-120B and MC-143)

Name .....

Company .....

Street .....

City ..... *Zone* ..... *State* .....

Booth 1414, New York Coliseum

NOW . . .

high efficiency

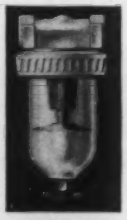
Filters, Regulators, and Lubricators
for Air Supply to Pneumatic Equipment

with the NEW

WATTS high efficiency LINE

consisting of:

WATTS high efficiency FILTER



New TORNADO ACTION

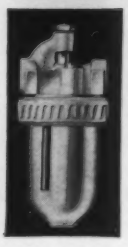
Contoured inlet eliminates drastic air pressure drop and forces the air into a downward spiral. This "Tornado Action" sets up centrifugal force which spirals dirt and moisture particles downward into the "quiet zone."

WATTS high efficiency REGULATOR

New ASPIRATOR ACTION

Watts Aspirator control acts directly on input valve, giving instant compensation for fluctuating pressure demands . . . provides precise control and stabilizes pressures reaching individual pieces of equipment.

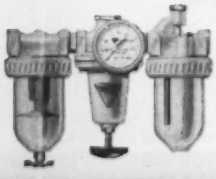
WATTS high efficiency LUBRICATOR



New BY-PASS PICKUP

Watts new By-Pass Pickup makes possible an exclusive high velocity venturi section which vaporizes virtually 100% of the metered oil. By-Pass permits maintenance of constant pressure in the venturi section with minimum pressure loss.

Complete range of Sizes: 1/4", 3/8", 1/2"



BOWLS CAN BE REMOVED IN 30 SECONDS

Write for catalog and specification sheets on WATTS high efficiency line.

WATTS REGULATOR COMPANY
SINCE 1875

12 EMBANKMENT ROAD LAWRENCE, MASSACHUSETTS

New Parts

(Continued from Page 221)

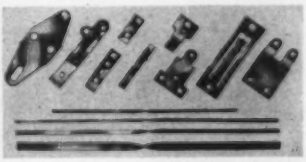
tems. Made to conform to military temperature specifications, they withstand temperatures to 200 C, and operate to −60 C. Switches are of glass tubing, ground to exacting spherical radius of curvature. One hollow and two solid platinum leads are sealed into the surface. Electrolyte is inserted through hollow lead, which is then arc-welded closed. Calibration is made during filling operation. **Corning Glass Works,** Corning, N. Y.

Circle 839 on page 19

Electrical Contacts

are formed from electrical contact tape

Contact material in tape form is preformed to finished shapes with close tolerance limits. Electrical contact tape assemblies require less contact volume for required elec-



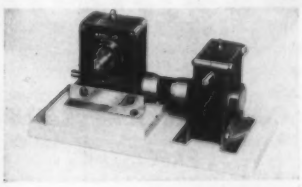
trical and thermal characteristics, and have approximately 70 per cent of the face area of rivets for equivalent electrical capacity. They are rolled to finished form and normally supplied with serrated base-metal backing to facilitate welding. **Metals & Controls Corp.,** General Plate Div., Forest St., Attleboro, Mass.

Circle 840 on page 19

Speed Reducers

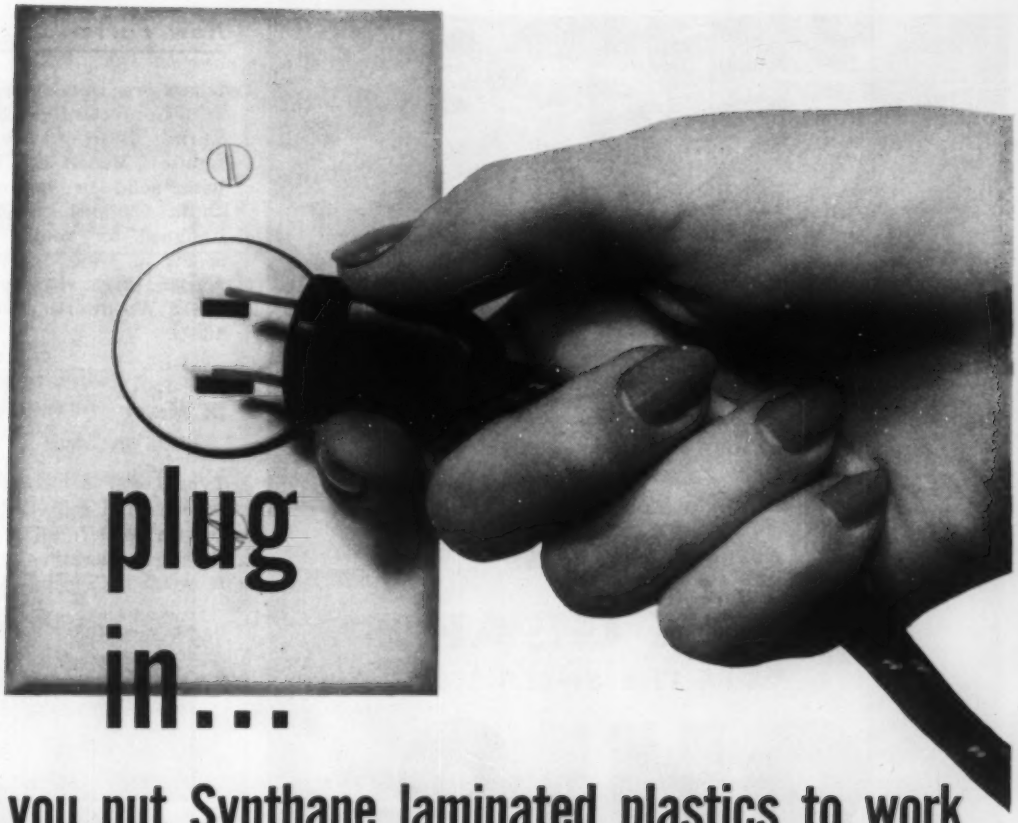
for fractional-hp motors

Five speed reducers with ratios from 15:1 to 60:1 provide nineteen ratios from 15:1 to 3600:1

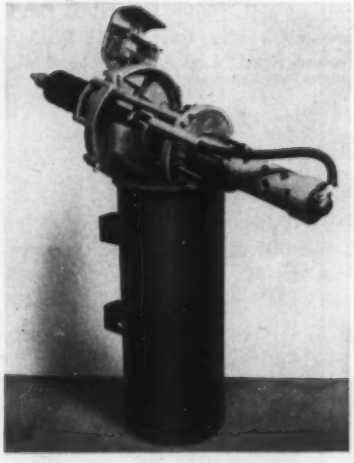


by being paired in fourteen different combinations. Units com-

Circle 514 on page 19



and you put Synthane laminated plastics to work



Automatic Circuit Recloser Parts made from Synthane sheet and tube provide insulation for high voltages.

Think of the many conveniences available simply by plugging into an electrical outlet.

On both sides of the outlet Synthane laminated plastics are at work in power generation and distribution, home appliances and other electrical equipment.

You find Synthane laminated plastics in circuit breakers, buss bar coverings, transformers. Synthane laminated plastics are important insulators in toasters, ranges, food mixers. Synthane is at work in thermostats, voltage regulators, power tools.

Synthane is valued in electrical applications chiefly for its high dielectric strength, low moisture absorption and low dissipation factor plus its additional properties of dimensional stability, machinability and mechanical strength. Synthane is available in over 30 standard grades in sheet, rods, tubes or you can avail yourself of our complete fabricating services.

For more information about the many properties of Synthane and how you can benefit by using Synthane materials and fabricating services, write for our product catalog. Synthane Corporation, 5 River Road, Oaks, Pennsylvania.

DIELECTRIC STRENGTH | IMPACT STRENGTH | HEAT RESISTANCE | LIGHT WEIGHT

SYNTHANE ... industry's unseen essential

SYNTHANE CORPORATION, 5 RIVER ROAD, OAKS, PA.

STOCK GEARS
"OFF THE SHELF"
OHIO
SPECIAL GEARS
"TO YOUR SPECIFICATIONS"

POWER TAKE-OFF GEARS

• Ohio Stock Gears offer substantial savings in many ways — no wasting time — no delivery delays — replacement is quicker when you standardize with stock gears.

• Ohio Special Gears are the choice of designers and nationally known manufacturers because of their dimensional accuracies and qualities maintained through long experience and modern equipment.

• *There is an Ohio Gear distributor conveniently located near you—call him or write the factory direct.*

THE OHIO GEAR CO.
1338 E. 179 ST. • CLEVELAND 10, OHIO

ESTABLISHED 1915
OHIO GEARS

Circle 516 on page 19

New Parts

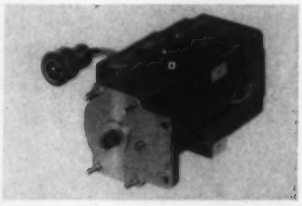
bine a precision-molded nylon gear with precision-machined steel worm. Bearings are of sintered bronze. Models can be furnished with solid or hollow low-speed shaft. Molded polyester case is designed for rough duty. Unit is 2⅝ in. wide, 1⅜ in. deep, and 3⅜ in. high. **Rampe Mfg. Co.**, 14915 Woodworth Ave., Cleveland 10, O.

Circle 841 on page 19

DC Motor

meets MIL-8609

Type D-927 dc motor for use on missiles and rockets gives reliable service under all conditions of shock, acceleration and vibration. It weighs 7.25 lb. Speed is con-



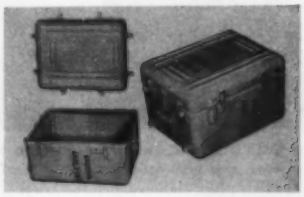
tinuous at 9900 rpm, load is 0.5-hp, and terminal voltage is 27 v, 18 amp. Unit meets Military Specifications MIL-8609. **Electrical Engineering & Mfg. Corp.**, 4612 W. Jefferson Blvd., Los Angeles 16, Calif.

Circle 842 on page 19

Aluminum Cases

in 24 basic sizes

Deep-drawn cases comply with all applicable sections of the latest revisions of specifications MIL-T-945, MIL-STD-108, MIL-T-4734

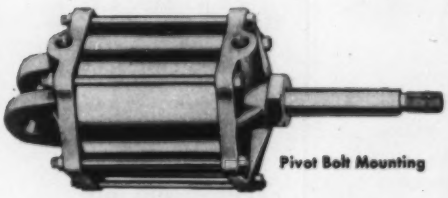


(USAF) and environmental conditions of MIL-C-4150. They can also be constructed and fitted to meet specific environmental requirements, such as water tightness, resistance to internal or external pressure or vacuum, drip and spray resistance, resistance to salt spray or chemicals, shock or

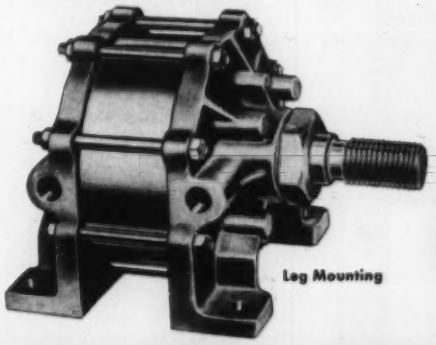
Schrader®...

your one source for AIR CYLINDERS

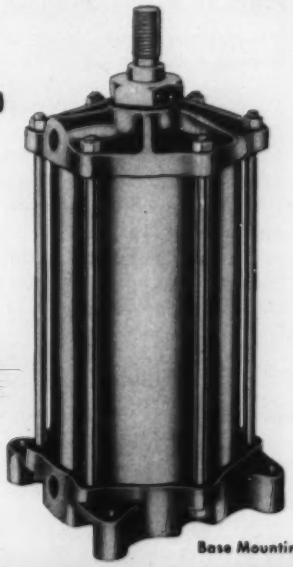
push, pull, single or double-acting, with or without cushion
. . . for every type and mounting



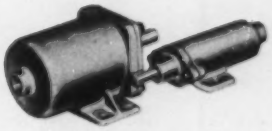
Pivot Bolt Mounting



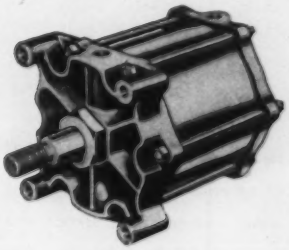
Leg Mounting



Base Mounting



Small
Clamping Cylinders



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Available for immediate delivery from your Schrader Distributor

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QUALITY AIR CONTROL PRODUCTS

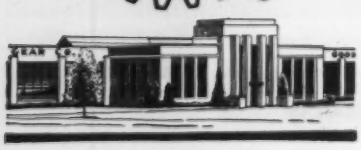
A little GOLD in our hair

PRESIDENT, THE CINCINNATI GEAR CO.

We're older than we look. In fact, our firm is 50 years old this year, and while we haven't *actually* taken to tinting our hair gold, we *are* doing our best to let everyone know about this, our golden anniversary. Because we think it's something of an accomplishment — 50 years of uninterrupted progress and growth and leadership in gear-making that have made our reputation "good as gold." That reputation has been as much the result of adhering to some old-fashioned ideas about craftsmanship, service and attention to details as it has been the result of aggressive pursuit of the latest technological advancements in gear manufacture. It's a reputation we've worked hard to earn in the 50 years past, and one we'll work equally hard to perpetuate in years to come . . . a reputation for producing the best in custom "gears . . . *good gears only.*"

THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
Fifty Years of "Gears—Good Gears Only"

CINTI®



Circle 518 on page 19

New Parts

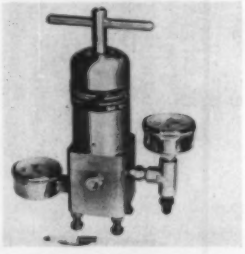
vibration mounting of contents, heat exchange or ventilation, electronic shielding, temperature or fungus resistance. Cases are available in 24 basic sizes with a variety of depths of case and lid. **Zero Mfg. Co.**, 1121 Chestnut St., Burbank, Calif.

Circle 843 on page 19

Pressure Regulator

regulates outlet from 0 to 3000 psi

Manually operated pressure regulator is designed for use in laboratories or in conjunction with portable or stationary air compressors. Inlet to regulator accepts stored air pressure to 3500 psi. Adjusting handle regulates outlet or delivery pressure in increments from 0 to 3000 psi. Regulator is spring-



loaded, balanced-pressure type and incorporates an integral relief feature which permits upward or downward adjustment of delivery pressure without separate relief of delivery pressure line. Materials are steel and aluminum, and finishes are designed for long service life when used with noncorrosive gases. With 3000-psi inlet pressure, pressure drop is less than 200 psi when flowing 15 scfm. **Cornelius Co.**, 550 39th Ave., N. E., Minneapolis 21, Minn.

Circle 844 on page 19

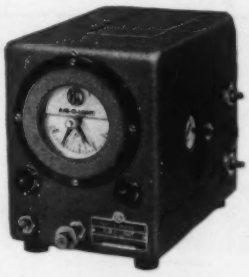
Data Amplifier

has gain constant to 0.1 per cent

Type 190 data amplifier, designed for dc amplification of thermocouple, strain-gage and similar signals, has a standard voltage gain of 1000. It has excellent stability, with no zero-point drift and gain remaining constant within 0.1 per cent over 1000 hr of operation, even with voltage variations of

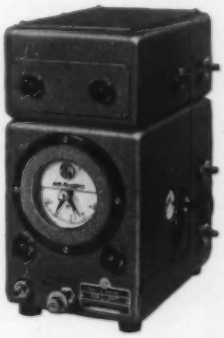
BUILD A GAGE INSTALLATION TO SUIT YOUR NEEDS . . .

with these packaged, on-the-shelf P&W Air-O-Limit Light Signal Units. Can be used to signal operator or to provide feed-back impulse for fully automatic process control.



BASIC 2-LIMIT UNIT . . . indicates high and low tolerances. Suitable for sorting and other "yes-or-no" control applications.

3-LIMIT UNIT . . . especially suited for grinding and similar operations. Indicates or automatically controls such conditions as: "Fast Feed," "Slow Feed," and "Spark-Out."



4-LIMIT UNIT . . . similar to 3-Limit Unit, but provides greater control scope. Indicates or controls such conditions as: "Approach High Limit," "High Limit," "Approach Low Limit" and "Low Limit."

Circle 519 on page 19

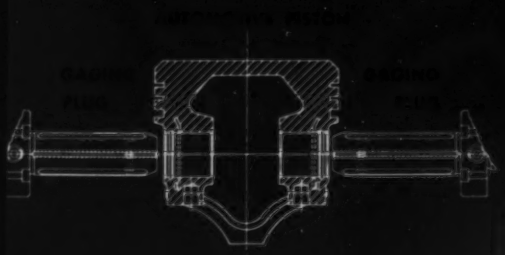


PHOTO COURTESY OF LASALLE TOOL, INC., DETROIT, MICHIGAN

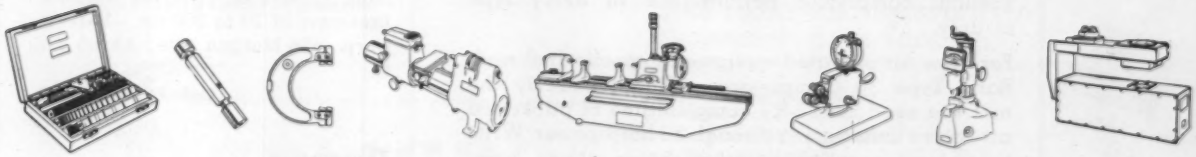
The EASY way to HIGH-PERFORMANCE DESIGN

PRATT & WHITNEY STANDARD, ON-THE-SHELF GAGE CONTROL UNITS

INCREASED OUTPUT RATES, INSURED ACCURACY, REDUCED REJECT RATES . . . these are the plus-performance factors that On-Machine or Automation Gaging can bring to a wide variety of production machines. And now, these standard P&W Packaged Units . . . with appropriate tooling . . . make it possible to provide an installation exactly tailored to your needs and easy to integrate into your present designs *without* the expense or delays required to engineer or construct special controls.

For example, these P&W Packaged Units made it easy to provide automatic on-machine gaging for this special, high-speed automotive piston machine produced by LaSalle Tool, Inc. Two P&W Air-O-Limit Carbide Gage Plugs are arranged to check the ID of both wrist pin bores on the pistons automatically. Lights on the P&W Control Units signal the operator if tolerances are exceeded. A second set of gage plugs similarly checks bores for the presence of snap ring grooves. If desired, control units can be arranged to shut down the machine automatically when an imperfect part is detected. Whatever *your* requirements, P&W can supply gaging equipment exactly right for the job.

For complete information, write to Pratt & Whitney Company, Inc., 33 Charter Oak Boulevard, West Hartford, Connecticut.



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PRATT & WHITNEY

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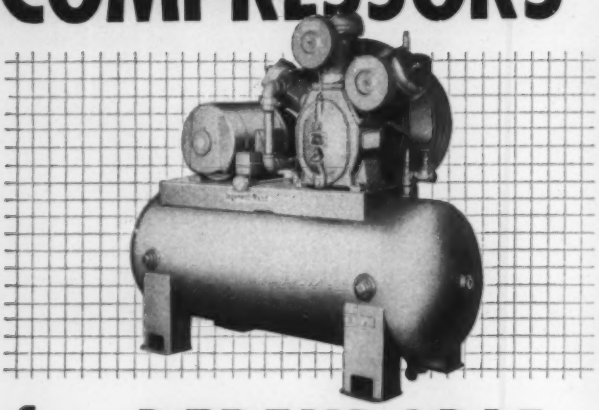
MACHINE TOOLS • GAGES • CUTTING TOOLS

Circle 519 on page 19

DESIGN WITH COMPACT

I-R COMPRESSORS



...for DEPENDABLE, long-life EFFICIENCY

When important production equipment depends on air for operation, you'll breathe easier knowing that the best compressors are there with the air—whenever needed. Ingersoll-Rand Type 30 Compressors are designed and built to exacting standards that insure efficient and continuous service.

Rugged construction and low maintenance have characterized I-R Compressors for years—and for years Ingersoll-Rand has set the standard for economical compressor performance in every type of duty.

For your air-operated equipment, specify Ingersoll-Rand Type 30 Compressors. Choose *exactly* the unit you need from I-R's complete line of packaged air-cooled units from ½ through 20 horsepower. Write today for descriptive literature showing bare, baseplate mounted or complete receiver mounted units.

Packaged air-cooled compressors—½ through 20 horsepower. Other compressors to 6000 horsepower.

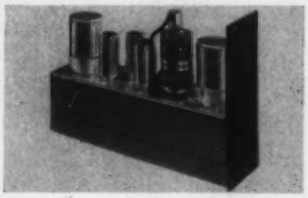
Ingersoll-Rand

11 Broadway, New York 4, N.Y.

3-495

New Parts

±10 per cent. This is a modular unit, with four amplifiers and accompanying power supply mount-



ing in 7 in. of standard rack space. **Offner Electronics Inc.**, 5320 N. Kedzie Ave., Chicago, Ill.

Circle 845 on page 19

Control Valves

for high-speed applications

Instant-action, pilot-operated, poppet-type in-line control valves are designed for brake, clutch and other high-speed applications. Designated Hi-Speed Inlines, the two and three-way valves provide fast response as a result of extremely short poppet travel. Simple in de-

sign and construction, the units have only three moving parts. Cast Navy M bronze valve body, stainless-steel moving parts and Hycar sealing materials provide excellent resistance to corrosion. Sizes range from ¼ to 1 in. NPT for working pressures of 10 to 200 psi. **Valvair Corp.**, 454 Morgan Ave., Akron 11, O.

Circle 846 on page 19

Thermostat

of stainless steel resists corrosion

Model 18000-26 Thermoswitch is fabricated of 316 stainless steel to provide corrosion resistance. Unit is particularly suited for service in 5 per cent sulphuric acid at tem-

Circle 520 on page 19

WHICH of these Actuation Problems are YOURS?

☐ POWER CONSUMPTION ☐ SPACE/WEIGHT ☐ PRECISION

☐ TEMPERATURE ☐ LUBRICATION ☐ DEPENDABILITY

SAGINAW b/b SCREWS will help you solve them!

ORIGINAL DESIGNERS
AND PRODUCERS
OF MULTIPLE
CIRCUITS
If one circuit should fail, the rest will function without interruption, sharing the load between them. In critical applications this feature has no equal.

6 BASIC DESIGN ADVANTAGES

1. Vital Power Savings. Permit much smaller motors with far less drain on electrical system, simpler circuitry.

2. Space/Weight Savings. Screws themselves are smaller, lighter; permit smaller motors and gear boxes; eliminate auxiliary equipment required by hydraulics.

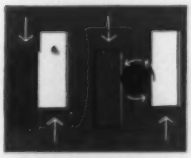
3. Precise Positioning. Machine-ground type will position components far more precisely than hydraulics or pneumatics; tolerances on position are held within .0006 in./ft. of travel.

4. Temperature Tolerance. Normal operating range from −75° to +275° F.; in selected materials, will function efficiently at temperatures as high as +900° F.

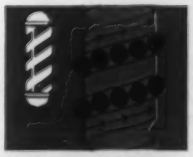
5. Lubrication Latitude. If lube fails, will still function with remarkable efficiency. Units have been built and qualified for operation without lubrication.

6. Fail-Safe Performance. Far less vulnerable than hydraulics; Gothic-arch grooves, yoke deflectors and multiple circuits provide added assurance against failure.

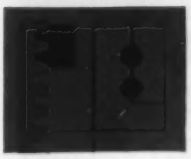
Here's why they're 90% efficient, save 4/5 on torque:



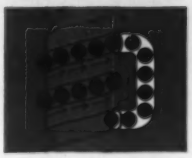
Let's start at the beginning, with the familiar principle that there's far less friction in *rolling* than in *sliding*. By applying this principle,



Like stripes on a barber pole, the balls travel toward end of nut through spiral "tunnel" formed by concave threads in both screw and mating nut.



the *Saginaw ball/bearing Screw* radically increases the efficiency of rotary-to-linear motion (and vice versa). Instead of *sliding*, mating surfaces *glide* on rolling steel balls.



At end of trip, one or more tubular guides lead balls diagonally back across outside of nut to starting point, forming closed circuit through which balls recirculate.

Available in custom machine-ground and stock rolled-thread types. Units have been built from 1½ inches to 39½ feet long—⅜ to 10 inches in diameter.

This revolutionary new kind of spline utilizes the same basic principle pioneered by Saginaw in the ball bearing screw.

It permits new engineering designs never before practical—literally lets you achieve the "impossible"! In any application where column length must change under torque load, the Saginaw b/b Spline offers greatly decreased friction, less wear, longer life, more dependable operation. It can be fitted with integral gears, clutch dogs, bearing and sprocket seats or a wide choice of other attachments for use with electric, hydraulic or pneumatic units. To convert push-pull to rotary motion, helical types are available with very high leads, ranging from 20:1 to 100:1.

Outstanding opportunities for qualified engineers

Saginaw

b/b ball bearing Screws and Splines

SAGINAW STEERING GEAR DIVISION OF GENERAL MOTORS • SAGINAW, MICHIGAN

WORLD'S LARGEST PRODUCER OF BALL BEARING SCREWS AND SPLINES

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Saginaw Steering Gear Division
General Motors Corporation
b/b Screw and Spline Operation
Dept. 9H, Saginaw, Michigan

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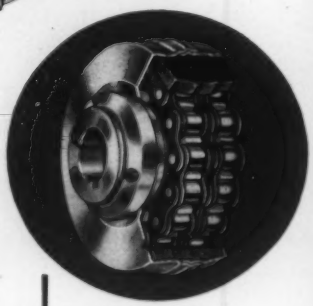
Now you can get prompt service on precision, high capacity, Acme Flexible couplings, available in fractional to hundreds of horsepower ratings, direct from your Acme chain distributor.

Acme flexible couplings are used to connect two revolving shafts together, and to compensate for angular and parallel misalignment. Simple to install and disconnect by merely removing one pin.

Maximum capacity is obtained by distributing the load over all the coupling teeth.

An important plus is Acme's use of convex rollers which allow greater angular and radial misalignment. This is accomplished with a minimum amount of backlash. See your Acme distributor.



Each Acme coupling is complete with standard keyways and set screws. Grease retaining felt and snap-on cover can be furnished if required.

FREE FLEXIBLE COUPLING CATALOG

Write Dept. 6-K for new Acme Flexible Coupling Catalog. Just off the press.

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Acme Chain Corporation
HOLYOKE
MASSACHUSETTS

New Parts

peratures up to 120 F, in acetic acid vapors, halide solutions, alkaline solutions, and in other materials to which Type 316 stainless is resistant. It provides excellent

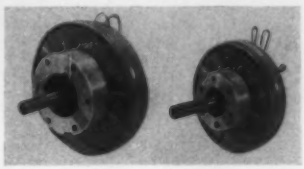
service in all types of photographic solutions. Unit is supplied with coupling-head mounting having ½-14 pipe thread for direct threading into a tank or pipe wall. Control temperatures are adjustable over a range of −100 to 400 F. Current rating is 10 amp, 115 v ac, or 2 amp, 115 v dc. **Fenwal Inc.**, Ashland, Mass.

Circle 847 on page 19

Magnetic Brakes

have power torque ratings from 125 to 650 lb-ft

Power-Safe brakes combine high torque and fast cycling with ability to hold or stop load if power fails. Four basic sizes of brakes



are available with power torque ratings from 125 to 650 lb-ft and fail-safe torque ratings from 33 to 205 lb-ft. Brakes are self-adjusting for wear, and are easy to mount with either inside bolt circle or outside mounting flange. **Warner Electric Brake & Clutch Co.**, Beloit, Wis.

Circle 848 on page 19

Motors and Generators

ventilation system expels air at commutator end

Life-Line H series of direct-current industrial motors and generators have drip-proof enclosures and NEMA Class B ratings. Motor ratings range from 1 to 150 hp and generator ratings from ¾ to 100 kw. Design features include use of a high-temperature silicone insulation system in machines rated

A copy for every designer

Table of Contents

Research and Development
General Product Description
S.A.E. Nomenclature
Metal-Encased Oil Seal Designs
One-Piece Molded Oil Seal Designs
Split Seal Designs
Victor Production Facilities
Victoprene Compounds
Synthetic Rubber Elastomers Chart
Applied Sealology
Peripheral Speeds Chart
O.D. Press Fit Chart
Application Design Features
Installation Data
Oil Seal Application Index
Seal Sizes and Types—by Shaft Diameter
Seal Sizes and Types—by Numerical Listing
Metal-Encased Felt Seal Listing

Compiled Entirely to Serve Specifier's Needs

You'll quickly see this is not just the usual reference catalog that tells you what you can have. Instead, this new, modern edition shows and tells you how to get the oil seal you need—and how to insure effective performance.

60-page working guide

Here you will find all essential data for modern oil seal specification procedure—much of it in useful form for the first time in any catalog. Every section in the contents table offers valuable help toward better shaft sealing.

Note 2 outstanding features:

All sizes and types of Victor designs are grouped by shaft diameter—the primary consideration. A cross section of each design is immediately adjacent for quick reference.

Specific recommendations are given on design adaptability in relation to pressure, temperature, and shaft speed conditions.

Your copy sent on request

The more you use this catalog, the more you will be impressed with the fact of Victor's pre-eminence in the quality oil seal field, both in meeting your standard as well as custom requirements.

Victor Mfg. & Gasket Co., P. O. Box 1333, Chicago 90, Ill. In Canada: Victor Mfg. & Gasket Co. of Canada Limited, St. Thomas, Ont.

VICTOR

Sealing Products *EXCLUSIVELY*

OIL SEALS • GASKETS • PACKINGS • MECHANICAL SEALS

Circle 515 on page 19

No chance that scooping up 6 cubic yards of dirt will stall the engine powering this shovel. It has a National Torque Converter absorbing 490 hp. Other converter sizes range from 100 to 1000 horsepower capacities.

How to give big machinery a non-stall engine

You simply install a National Torque Converter. With that, it becomes practically impossible to stall or even overload the engine. It also becomes almost automatic for the machine to put out a bigger day's work.

As illustration, the bucket of a big power shovel may bite a bigger rock than it can lift. Ordinarily, the engine would stall, the whole power train would take a walloping shock load, and time would be lost. But with a National Torque Converter, the engine would not stall even if the bucket were stopped dead.

This is because a National Torque Converter regulates power and speed automatically, and does it quicker, more smoothly than a human operator can. In this way it lets the operator concentrate on other parts of the job to be done. The engine operates at optimum capacity all the time, whether the load is light or heavy. The torque converter acts as a fluid cushion to protect the engine and other parts of the machine from vibration and shock. Total maintenance costs take a nosedive.

A National Torque Converter may make your big, heavy-duty machinery more productive and more profitable. To get the whole story, write for an engineering appraisal of your power transmission problem to: The National Supply Company, Two Gateway Center, Pittsburgh 22, Pennsylvania.

THE NATIONAL SUPPLY COMPANY

INDUSTRIAL PRODUCTS DIVISION

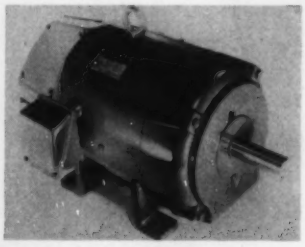
Two Gateway Center, Pittsburgh 22, Pa.

Pace-setters in the progress of industrial power transmission

Circle 524 on page 19

New Parts

to operate within Class B temperatures, controlled ventilation system, and new housing construction which enables the machines to serve many applications which



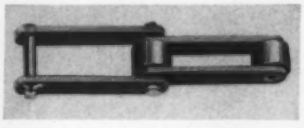
would require splashproof equipment. Decrease in armature inertia and improved commutating ability provide extremely fast dynamic response. **Westinghouse Electric Corp.**, P. O. Box 2278, Pittsburgh 30, Pa.

Circle 849 on page 19

Transmission Chains

are bushed and bushed-roller types

Line of SS-type chains for conveyor, elevator and power transmission uses includes five sizes of bushed chains and fifteen sizes of bushed-roller chains. Sizes range



from 2.609 to 9.00-in. pitch with ultimate strengths from 13,000 to 100,000 lb. The all-steel chains have locked-in, nonrotating pins and bushings, and are furnished in either straight or offset-sidebar construction. **Majestic Stamping Co.**, 9310 Hubbell Ave., Detroit 28, Mich.

Circle 850 on page 19

Hose and Hose Couplings

for temperatures from −40 to 275 F

Surgepruf medium-high and high-pressure hydraulic hose and hose couplings eliminate need for skiving rubber-covered wire-braid hose. Reusable couplings grip solidly on either single or double wire-braid hose without weakening protective

LONGER SOLENOID LIFE...

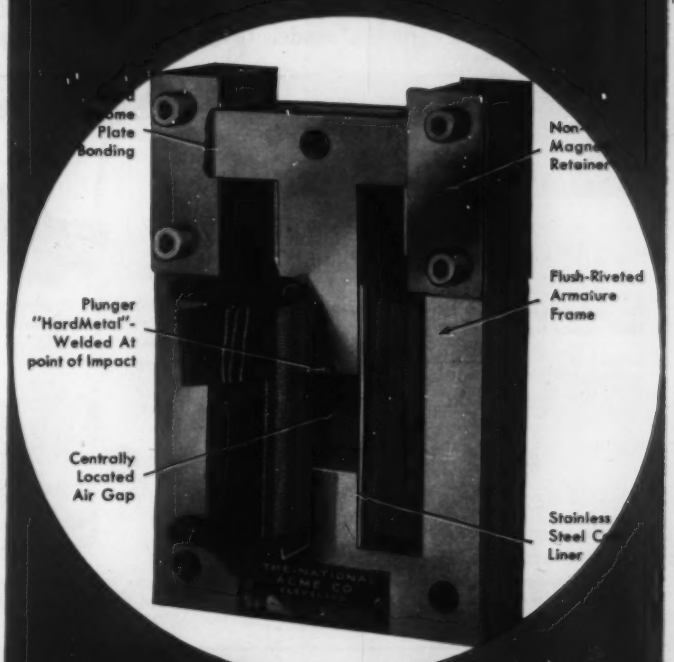
with NAMCO'S exclusive "HARDMETAL"-welded plunger bonding

Standard or Custom Models To Fit Your Design

"HardMetal"-welded plunger bonding prevents mushrooming at the vital point of impact—withstands incessant pounding of the plunger on the frame. Long plunger life, and thus long solenoid life, is further insured by hard chrome plating upper guide edges of plunger laminations to reduce friction and wear.

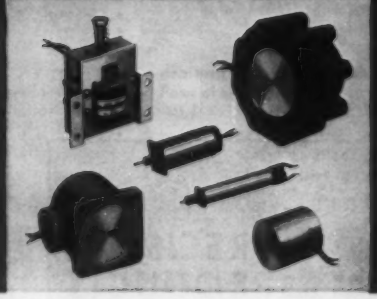
Namco standard solenoids are available in six series of pull and push types; custom-engineered solenoids in every size and type can be made to meet your specifications.

Standard "HardMetal"-Welded Solenoids are furnished push or pull type in sizes with ratings from 2-1/2 to 21 pounds at 1/2" stroke and from 2 to 25 pounds at 1" stroke.



← Saddle step applied to Series K200 standard Namco push type solenoid.

To meet specific job requirements, solenoids of special shapes and sizes are designed and built through cooperation of our engineers with yours.



Ask us to send a National Acme Representative to discuss your problems, or if you want more information first—send for BULLETIN EM-52.

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National Acme

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Circle 525 on page 19

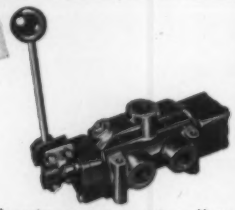
ADEL *Industrial Hydraulic Equipment*

for PEAK PERFORMANCE ADEL Hydraulic Valves and Pumps are setting new and ever higher standards for precision in manufacturing and efficient performance in operation. Following are but a few of the wide variety of models to meet all operating conditions.

GEAR-TYPE HYDRAULIC PUMPS

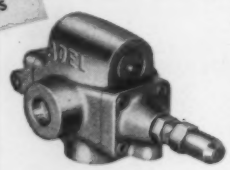
For 1000 psi service with rated capacities at 1800 rpm of from 1.5 to 46.8 gpm.

DIRECTIONAL CONTROL VALVES



4-way valves with spring-centered, spring-offset, and 1, 2, or 3 position detent action. 1500 psi. Flows to 28 gpm.

BY-PASS VALVES



Relief, Sequence and Unloading valves. Direct or remote operation, 50 to 1500 psi range.

VOLUME (FLOW) CONTROL VALVES

Compensated type maintains constant flow over wide differential pressure range. No drain line required. 1500 psi.

PILOT VALVES

2 or 3 position detent. With or without dog or lever. Can be used as 4-way valve in small circuits. 1000 psi.

CHECK VALVES

Valves allow free flow in one direction only. Many variations available. 3000 psi.

Reliability

ADEL PRECISION PRODUCTS

A DIVISION OF GENERAL METALS CORPORATION

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Manufacturers of MARINE & INDUSTRIAL HYDRAULIC CONTROL EQUIPMENT

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Industrial Air & Hydraulic Equipment Company
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TEXAS ·
Air-Draulic Equipment Company
Houston, Texas

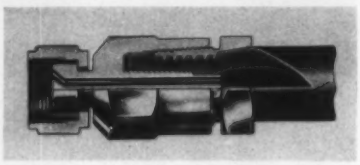
UTAH ·
Robert Taylor & Sons
Salt Lake City 10, Utah

WASHINGTON ·
Haskel Engineering & Supply Co.
Seattle, Washington

Circle 526 on page 19

New Parts

cover or waterproofing qualities. Hose, constructed of seamless inner tube of synthetic rubber reinforced by a single steel braid for medium-high pressure, or two layers of steel-wire braid sepa-



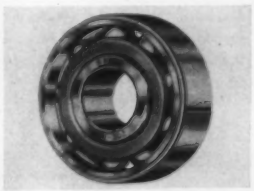
rated by a layer of synthetic rubber for high-pressure systems, has operating temperature range of −40 to 275 F and burst range of 1400 to 18,000 psi. Hose resists abrasion, oil and weather. **Stewart-Warner Corp.**, Alemite Div., 1826 Diversey Pkwy., Chicago 14, Ill.

Circle 851 on page 19

Ball Bearings

have one-piece retainer construction

New ball bearings have a fractured outer ring, permitting the introduction of a maximum complement of balls. Fractured ring closes by its own resiliency and is secured by circumferential holding



wires or rings. This technique provides no loss of thrust load-carrying capacity, increased load capacity and life, and simplification of ball-retainer construction. Type HDR (shown) is available in 48 sizes in extra-light, light and medium series. **Split Ballbearing Corp.**, Lebanon, N. H.

Circle 852 on page 19

Temperature Control

operates at temperatures from −400 to 3000 F

Series 2300 thermocouple temperature control consists of a very high sensitivity meter-relay and load relay, together with other components for complete control, con-

Design "Low Cost" Into YOUR Equipment

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World's Largest Selection of Low-Cost Lubricating Devices

LUBRIKIT . . . An assortment of 95 oil cups of 29 different types. Gits sales records show these oilers are most used for replacement and maintenance. Contents of each separate bin are clearly described on Inside Cover.

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CLIPS FOR ATTACHING TUBING

When ordering, specify ¼", ⅜" or ½" tubes. Style TF.

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Double Clips

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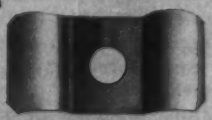
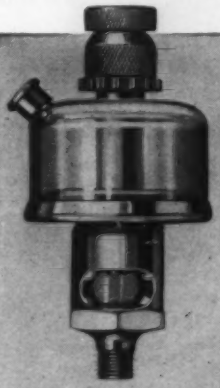


Double Clips — Wing Type



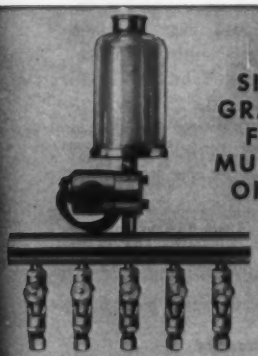
SIGHT GRAVITY FEED OILERS

Rate of oil flow regulated by needle valve, directly observed through sight glass in stem.

Shut-off knob does not affect needle valve adjustment. Visible oil supply. Non-breakable. Tops in convenience and dependability, at low cost. Style NFU—No. 3602-A.

GEAR CASE GAUGES

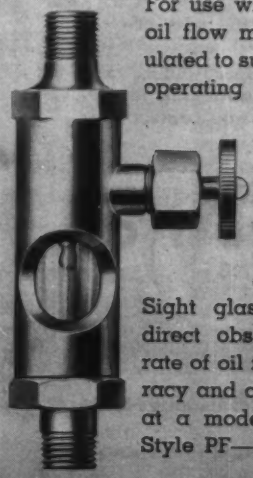
This oil gauge plug permits instant checking of oil level within a transmission or gear case. For use where construction permits insertion in tapped hole. A valuable addition to any such equipment — at very low cost. Style BW—No. 4042.



SIGHT GRAVITY FEED MULTIPLE OILERS

This one unit replaces 3 to 8 individual oilers. Maximum practicality in a small central lubrication system. Positive cut-off during idle periods. Individual vibration-proof needle valve adjustments. With solenoid control (illustrated): Style MDS—No. 4685-A. Without solenoid: Style MD.

SIGHT GAUGES



For use where rate of oil flow must be regulated to suit changing operating conditions. Needle valve permits extremely accurate adjustment of oil feed. Sight glass provides direct observation of rate of oil flow. Accuracy and convenience at a moderate price. Style PF—No. 4290.

Don't price yourself out of the market. When you design proper lubrication into your equipment, specify GITS Lubricating Devices—the widest selection available anywhere. The items pictured above are only a few of our many thousands of lubricating devices. At the design stage, get the GITS story. Free Engineering Service. Send NOW for your free Catalog.

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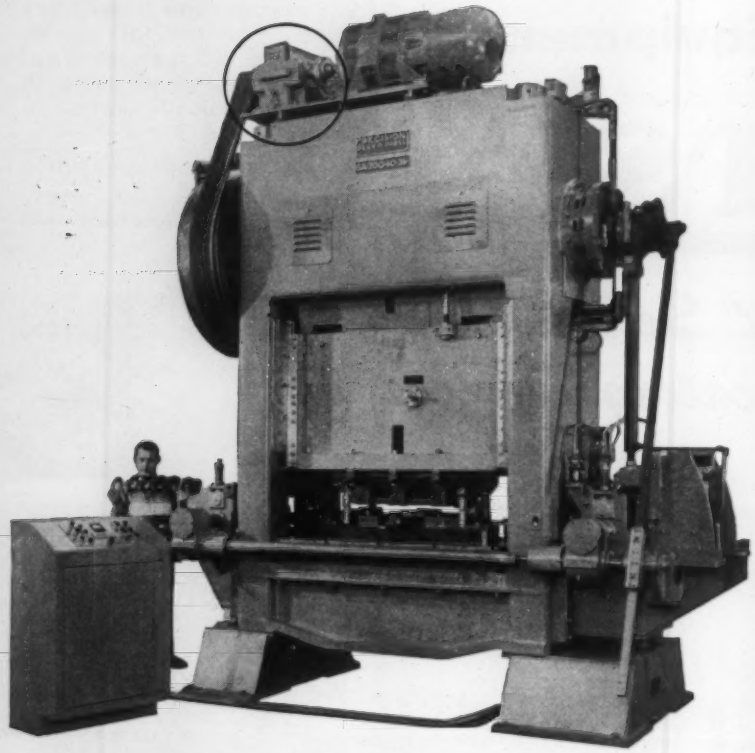
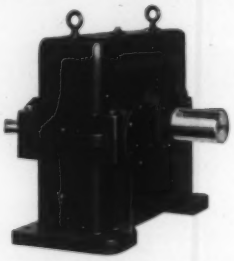
Circle 527 on page 19



H & S speed reducer helps increase Flexopress drive efficiency!

Located in the Hayes Industry Plant at Jackson, Michigan, this Flexopress has greatly increased production efficiency. Operating at double the slide speed previously obtainable, it's the world's fastest press for comparable size and stroke.



H&S RS1600 Speed Reducer

A high speed motor was specified for greater operation economy. Resultant high shaft speed had to be reduced to desired flywheel speed. For this, Precision's engineers selected a compact, easy-to-install H&S speed reducer as the neatest and most efficient drive linkage available.

Perhaps you, too, can benefit from our years of speed reducer and industrial gear engineering experience. If you are looking for dependable, trouble-free power transmission, won't you contact your H&S representative or write us today?

THE HORSBURGH & SCOTT CO.

GEARS AND SPEED REDUCERS

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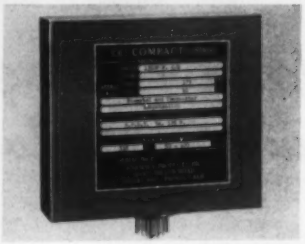
Send note on company letterhead for H&S Reducer Catalog No. 55

New Parts

tained in a single, compact package. Control action is either limit or automatic. Limit compacts, which trip a relay and lock, must be reset externally. They are used for temperature monitoring or alarm. Automatic compacts in-



clude an automatic interrupter for periodic reset, and will control heaters or coolers. Operating temperature range is from −400 to 3000 F. Mounting is 9-pin plug-in octal type. Power requirement is 115/230 v ac, 50/60 cycles. **Assembly Products Inc.**, P. O. Box XX, Palm Springs, Calif.

Circle 853 on page 19

Pressure Regulator

for aircraft and missile applications

Low pressure reducing regulator can be used to supercharge hydraulic reservoirs, as a lubrication system regulator, or in a canopy-seal system. Developed for applications in aircraft and missiles, it is adjustable from 20 to 40 psig and accurate to better than 5 psi with flows from slight bleed to 7 scfm. Unit is not affected by extreme altitudes and can be used with air, nitrogen or helium in ambient temperatures from −65 to 250 F. It withstands 25 *g* vibration from 25 to 2000 cps. **Darco Industries Inc.**, Val-Aero Div., 2151 E. Rosecrans Ave., El Segundo, Calif.

Circle 854 on page 19

Cable Clamps

are applied without disassembly

Series 480 clamps provide smooth, quick cable installation, since they can be applied without being disassembled. Nuts have been eliminated. Universal parallel groove

EQUIPMENT MANUFACTURERS:

PROCESS CONTROLLERS

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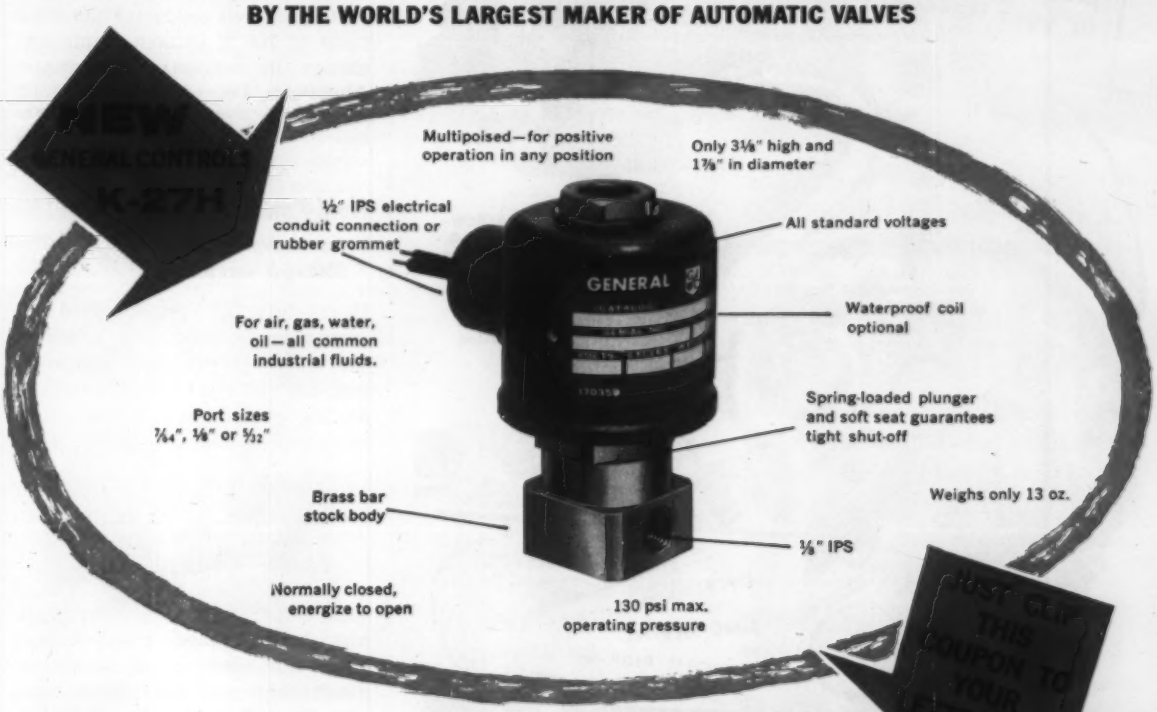
BY THE WORLD'S LARGEST MAKER OF AUTOMATIC VALVES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GENERAL CONTROLS
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Multipoised—for positive operation in any position
Only 3⅛" high and 1⅞" in diameter
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All standard voltages
GENERAL
Waterproof coil optional
For air, gas, water, oil—all common industrial fluids.
Port sizes ¼", ⅛" or 1/32"
Spring-loaded plunger and soft seat guarantees tight shut-off
Brass bar stock body
Weighs only 13 oz.
⅛" IPS
Normally closed, energize to open
130 psi max. operating pressure
JUST CLIP THIS COUPON TO YOUR LETTERHEAD

MAKE YOUR OWN TEST

If you make equipment that incorporates small solenoid valves, you'll want to find out first-hand about this smaller and lower cost valve that will save space, reduce costs and (most important) deliver the goods in dependable performance.

We're so convinced this new K-27H Midget Solenoid Valve will give you all three, we'd like you to try it on your equipment for size—savings and performance. Send in the attached coupon.

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Please send me a free sample of your new K-27H Midget Solenoid Valve for test and evaluation on equipment we manufacture for sale.

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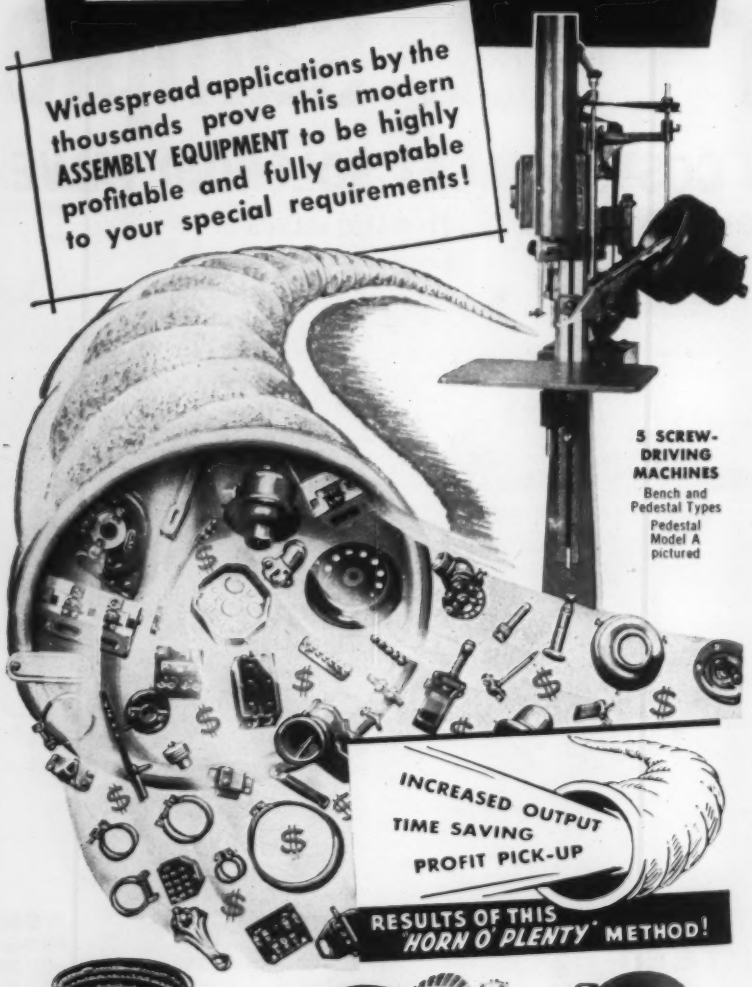
Widespread applications by the thousands prove this modern ASSEMBLY EQUIPMENT to be highly profitable and fully adaptable to your special requirements!



5 SCREW-DRIVING MACHINES
Bench and Pedestal Types
Pedestal Model A pictured

BOWL FEEDER
Electrical vibratory type to feed parts that cannot be tumbled.

BARREL FEEDER
with stationary ring cover for heavy-duty production.

BARREL FEEDER
Popular motorized type, for parts requiring critical selection.

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DETROIT POWER SCREWDRIVER CO.

2801-A W. FORT STREET DETROIT 26, MICHIGAN

New Parts

design permits three clamps to cover full range from No. 2 to 397.5 MCM in ACSR, and from No. 2 to 400 MCM in stranded aluminum conductor. Top and bottom parts

of the clamps are aluminum alloy extrusions. Bolts are anodized to reduce thread friction. Test currents produced conductor temperatures of 200 F without significant change in connection resistance. **Aluminum Co. of America,** 1501 Alcoa Bldg., Pittsburgh 19, Pa.

Circle 855 on page 19

Fluid-Power Cylinders

for heavy-duty, 3500-psi service

Heavy-duty, 3500-psi, standard and large-ram, double-acting cylinders provide dependable, leakproof, long-life operation under severe operating conditions. Cylinders are thick-walled, seamless steel, preci-

sion bored, honed, polished, and gaged for accuracy of roundness, straightness and size. Eight basic sizes from 2 to 8 in. are available, with either standard or large-diameter rams. Length of stroke varies from 36 to 158 in. **Oilgear Co.,** 1560 W. Pierce St., Milwaukee 4, Wis.

Circle 856 on page 19

Synchro Indicator

indicates oil, fuel, hydraulic, water pressure

Type 26800 aircraft synchro indicator can be used in any electronic system that provides a synchro output or in any electrical system in which remote position indication is desired. Hermetically sealed unit, 1 in. in diameter and weighing less

Circle 530 on page 19

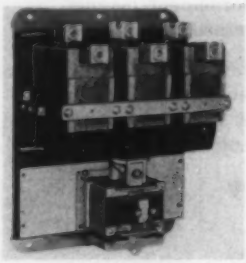
than 3 oz, meets military specification I-25540A. Designed for 26-v, single-phase, 400-cycle operation, the unit operates with many standard pressure transmitters to indicate oil, fuel, hydraulic or water pressure. It is designed for clamp mounting in the instrument panel in accordance with AN5808-4. Electrical connection is made with standard subminiature connector. **Bendix Aviation Corp.**, Montrose Div., South Montrose, Pa.

Circle 857 on page 19

Contactor

for motor starters and controllers

New 150-amp, NEMA Size 4, ac solenoid contactor has long-life, simple solenoid design and exceptional compactness. Contactor, which may be applied as main-line, accelerating or reversing type, is for use in motor starters and con-



trollers. Other applications include control of heater and lamp loads. Stationary contacts feature one-piece design with heavy-duty lug accessible from the front. Standard coil voltages are 110, 220, 400 and 550 v at 25 or 50/60 cycles. Basic contactor is 10 15/16 in. wide, 13 7/16 in. high and 6¾ in. deep. **Ward Leonard Electric Co.**, 115 MacQueston Pkwy., Mt. Vernon, N. Y.

Circle 858 on page 19

Damping Device

controls linear or rotary forces

Eddy-Trol damper utilizes eddy-current principles to provide efficient, smooth torque for damping control of linear or rotary forces. Input force is transmitted through a precision gear train which ro-

Thoroughly Proved...

BY YEARS OF HARD EVERYDAY USE ON FLUID LINE CIRCUITS

HANSEN
QUICK-CONNECTIVE
PUSH-TITE COUPLING

instant automatic flow and shut-off
quick connection and disconnection
leak-proof minimum wear locking device
integral factory assembled tamper-proof socket head

ONE-WAY SHUT-OFF

Locking pins in Hansen Push-Tite Coupling Socket afford large area contact with Plug, thereby preventing wear and subsequent leakage.

• The ability of Hansen Push-Tite Couplings to withstand severe service—with practically no maintenance—has been thoroughly proved by years of hard, everyday use on hundreds of fluid line circuits. The "socket head", which contains the locking device, is factory assembled into a rugged integral unit which cannot be readily injured or have component parts lost by casual tampering.

To connect the Coupling, you merely push the Plug into the Socket with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket—Coupling disconnects. Flow is shut off instantly and automatically.

QUICK-CONNECTIVE FLUID LINE COUPLINGS for

AIR
OIL
GREASE
HYDRAULIC FLUIDS
WATER
VACUUM
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Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes of Hansen One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings—including Special Service Couplings for Steam, Oxygen, Acetylene, etc.

SINCE 1915

QUICK-CONNECTIVE FLUID LINE COUPLINGS

THE HANSEN MANUFACTURING COMPANY

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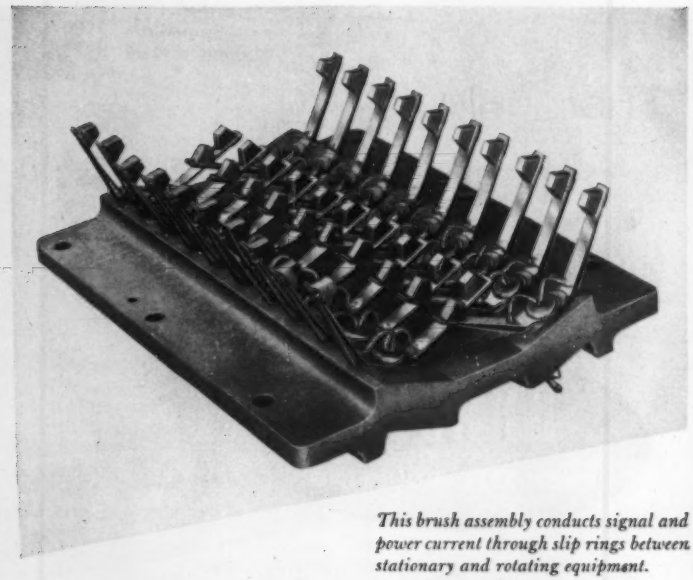
Circle 531 on page 19



This brush assembly conducts signal and power current through slip rings between stationary and rotating equipment.

VITAL CONTACTS !

● Trust our 37 years' experience to design and construct *specially* the *right* contact for your job. Importantly, the *material* must be *right.* From literally hundreds of grades *of our own manufacture* Superior will recommend the grade sure to give you maximum performance. Size, shape and other essentials will be *right.* Contacts, brushes, slip rings,—Superior takes on the entire project and carries it through from design to finished product. P. S.—Brand new applications intrigue us particularly.

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SUPERIOR CARBON PRODUCTS, INC.
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SCP J4
SUPERIOR CARBON BRUSHES
"Since 1919"

New Parts

tates a disk across permanent, high-intensity magnetic fields. Resulting eddy currents produce a damping torque directly proportional to input speed of rotation. Design features include: Alnico V permanent magnets, damping with-

out friction, zero hysteresis under all conditions, one-piece molded glass-fiber housing, and operating temperatures of −100 to 300 F. Models have damping rates from 50 to 1250 lb-in. **Lyndon Aircraft Corp.**, 140 Clifford St., Newark 5, N. J.

Circle 859 on page 19

Gearmotor

is permanent magnet governed planetary type

Gearmotor is a 30-v dc, permanent-magnet governed planetary type. It has 1.2 rpm output speed, ±1 per cent, with output torque of 16

oz-in., and requires 1 amp current at 30 v dc. Governor is applied in armature circuit without slip rings or brushes. Motor is 1¼ in. diam, 3 in. long, and weighs 7 oz. **Western Gear Corp.**, P. O. Box 182, Lynwood, Calif.

Circle 860 on page 19

Filters and Lubricators

for compressed air

Air-line filters and lubricators, designated Lubri-Air controls, filter and lubricate compressed air to insure maximum efficiency and life of pneumatic equipment. Water and dirt particles are forced to the base of the plastic reservoir, and smaller dirt particles are trapped by the filter, leaving pure outgoing air. Lubricator, by capillary action

Circle 532 on page 19

CUT COSTS

with the Original Mead

MIDGET AIR CLAMP

(Spring Return Air Cylinder)

In assembly jigs and other multiple applications, this new, low cost pressure unit saves countless man-hours. As a work-ejector in many fixtures, it is unexcelled.

Advantages over mechanical clamps

1 **All Air Clamps** in any set-up can be operated by a single master valve—the "lock-up" and release of assemblies is instantaneous.

2 **May be installed in cramped corners** difficult to reach with bulky mechanical clamps. Mead Midget is the most compact air cylinder, for its power, on the market.

3 **Equal ram pressure at any point** along stroke, making special, delicate adjustments unnecessary.

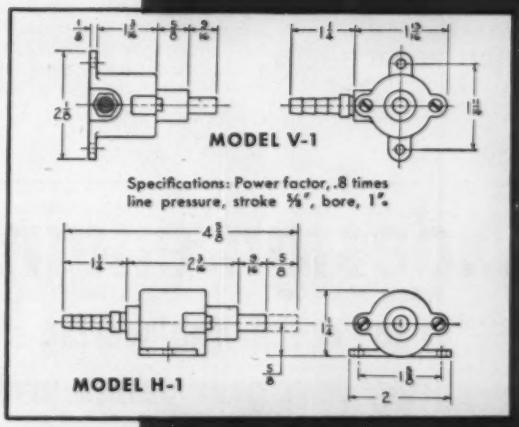
4 **Independent group control.** Any desired group of "Midgets" can be controlled independently of any other group in an assembly—as where primary members of the fixture must be locked up before the secondary members.

5 **Facilitates delicate drill operations.** Air Clamps actuated by foot control valves leave operator's hands free to handle the work pieces.

Send for all the interesting facts on these time-tested, superior Midget Air Clamps.

MEAD SPECIALTIES COMPANY

4114 North Knox Avenue • Dept. MD-57 • Chicago 41, Illinois



IMMEDIATE DELIVERY

Single-acting cylinders delivered from stock; double-acting in a few days.

New **MEAD INDUSTRIAL AIR POWER CATALOG**

MEAD

Air Operated Devices

Memo Coupon

MEAD SPECIALTIES CO.

4114 N. Knox Ave., DEPT. MD-57, Chicago 41, Illinois

Send free copy of new, colored MEAD INDUSTRIAL AIR POWER CATALOG describing the complete line of famous Mead air-operated devices.

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slash installation costs with

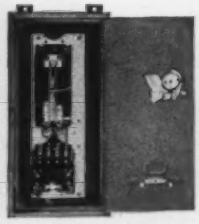
FEDERAL PACIFIC

Combination Motor Starters

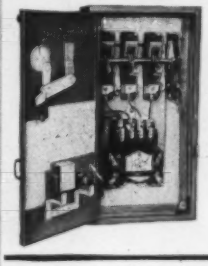
Finest Products Engineered

FEDERAL PACIFIC ELECTRIC COMPANY

50 Paris Street, Newark 1, N. J.



THERMAL MAGNETIC CIRCUIT BREAKER permits harmless temporary overloads; trips instantly when overload becomes dangerous... offers quick-make, quick-break action, thermal tripping element and deionization arc quenchers.



DISCONNECT SWITCH designed for cool operation, safety and long life. Features clear visibility, positive circuit opening and silver plated current carrying parts.

NOW Federal Pacific does away with the need for separate motor controls and safety switches or circuit breakers! Now you can meet all your needs with one simple space-saving device... and save money while you do it! You install only one device—save valuable time—conserve precious space! Faster, easier installation more than offsets the slightly additional cost.

Circle 534 on page 19

...design engineers

at the design engineering show bring your gear design problems TO THE "GEAR DESIGN CLINIC"

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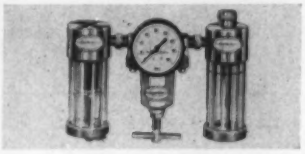
MASSACHUSETTS

DIVISIONS | GEAR SYSTEMS INC., WEST CONCORD, MASS.
MASSACHUSETTS GEAR & TOOL CO., WOBURN, MASS.

Circle 535 on page 19

New Parts

through a porous bronze wick and air pressure, provides instantaneous response of properly lubricated air, even during intermittent use. Oil-mist control gives full control



over wick area exposed to air stream. Port sizes available are ⅛, ¼, ⅜ and ½-in. **Bellows Co.**, Box 631, Akron 9, O.

Circle 861 on page 19

Flexible Shaft Terminals

for valve control

Terminals are valve couplings, intermediate connections to go through floors, and remote operating stations, for use with flexible shafting for remote control of valves. Model RIH remote operat-

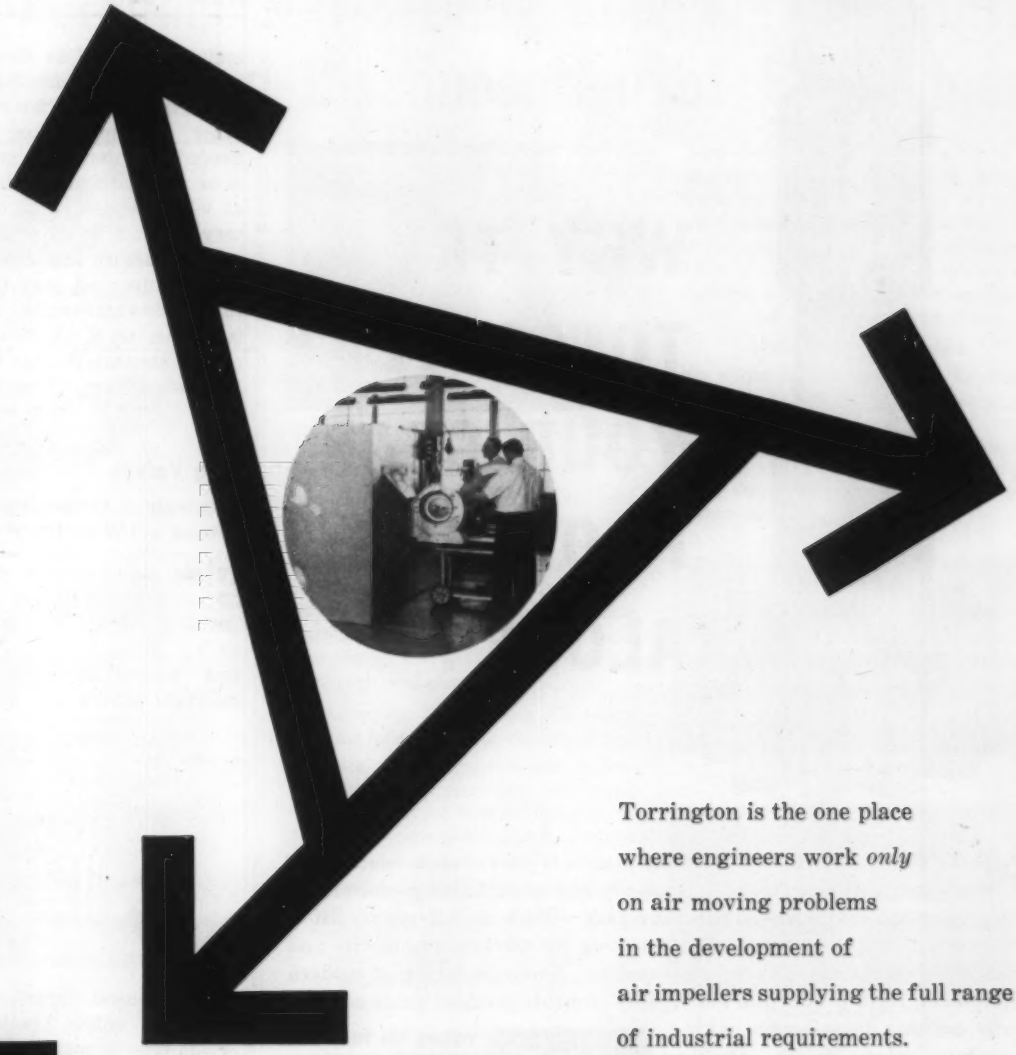
ing station is bolted in place and flexible shaft is pinned to the spindle. Models are available for connecting to ½, ¾, 1, 1¼ or 1⅝-in. flexible shafting. Valve couplings are designed to fasten to valve handwheel spokes by U-bolts. They are available for rising-handwheel valves, rising-stem gate valves, and nonrising-handwheel valves. **Stow Mfg. Co.**, 11 Shear St., Binghamton, N. Y.

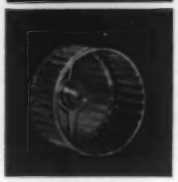
Circle 862 on page 19

Diesel Control Panels

automatically shut off engines

New safety panels that automatically shut off engines should oil pressure drop to a low level or engine water temperature rise to a high point provide continuous protection to engines on irrigation pumps, oil rigs, air compressors, generator sets, fork-lift trucks and refrigeration machines. Available for both battery and magneto-type





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problems are being studied today
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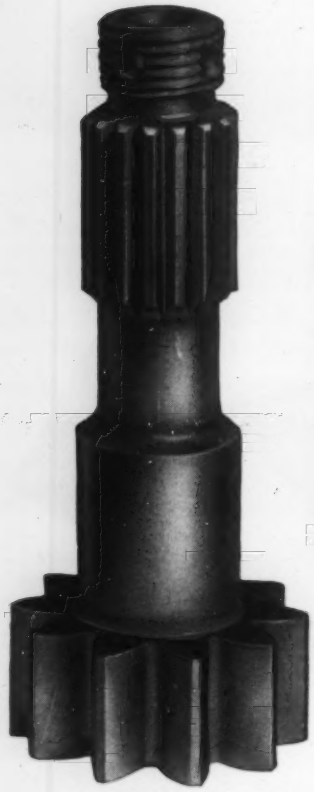

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Dept. 33, West Springfield, Mass.
Telephone: REpublic 7-4751

New Parts

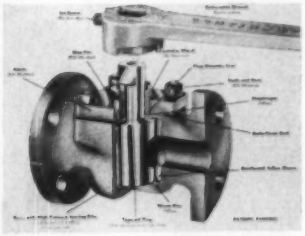
ignitions as well as diesels, panels include precut holes for insertion of a tachometer, hour meter or other instruments or gages as needed. Minimum oil pressure level or maximum engine temperature at which engine shuts off are factory-set at 5 lb oil pressure, 25 lb water pressure and 205 degrees of temperature; all may be adjusted to fit individual needs. Equipment is for use on 6, 12, 24 or 32-v circuits. **Stewart-Warner Corp.**, 1826 Diversey Pkwy., Chicago 14, Ill.

Circle 863 on page 19

Plug Valves

operate at temperatures from −150 to 400 F

Tufline stainless-steel plug valves are recommended for liquid and gaseous corrosives, solvent and slurry services, or for hydraulic and pneumatic services where standard valves will not seat due



to mechanical interference from entrained solids, polymerization, crystalline deposits or heavy slurries. Units have Teflon sleeves and internal ribbed construction. Valves operate continuously at temperatures from −150 to 400 F, and under pressures from 230 psi down to high vacuum. They are available in sizes from ¼ through 2 in. with screwed and flanged end. **Continental Mfg. Co.**, 247 Park Ave., New York 17, N. Y.

Circle 864 on page 19

Wireway Fittings

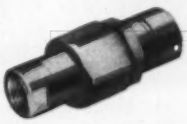
telescoping-type has adjustable length

Oiltight, telescoping wireway fittings are for use on machinery or buildings where oil and dust are problems. When incorporated into a wireway run, the telescoping section permits adjustment to any desired length. After unit is adjust-

Circle 537 on page 19

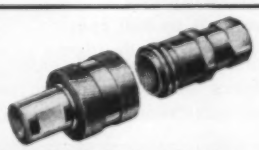
How Aeroquip Self-Sealing Couplings Simplify Connection and Disconnection of Fluid Lines

Industrial Type 5100 (wing union nut) or 5110 (hex union nut) for hydraulic fuel, oil, air and water lines.



Farm Type 5203 for hydraulic lines from tractor to farm implements.

Freon Type 5400 for precharging air conditioning lines and components at the factory.



LP-Gas Type 5104 for quick recharging of LP-Gas fuel tanks.

Aircraft Type 145-155 and 3200 for all airframe and engine oil, fuel, hydraulic, and pneumatic lines.

Railroad Type 510022 for quick, safe refueling of diesel locomotives.

Soap testing for leaks is speeded up by using an Aeroquip Self-Sealing Coupling to connect a 240 psi air line to a joint.

Fluid systems requiring frequent disconnection and reconnection can be improved and simplified with Aeroquip Self-Sealing Couplings. One Self-Sealing Coupling performs the same function as two shut-off valves. It occupies less space and speeds fluid line connection and disconnection.

All Aeroquip Self-Sealing Couplings have the following basic characteristics:

a. Quick, easy connection and disconnection of pressurized fluid lines, without loss of fluid or inclusion of air or foreign matter into the system.

b. Full fluid flow through connected coupling; leak-proof sealing of disconnected coupling halves under maximum line pressure.

c. Positive locking action on connection to prevent accidental coupling disconnection and flow shut off.

d. Simple, sturdy design, with sufficient valve strength for long, trouble-free operation.

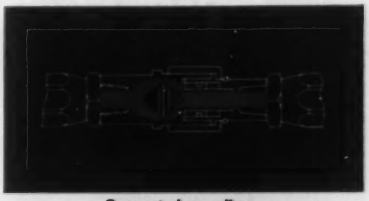
Poppet-Tubular Valve Design

Every Aeroquip Self-Sealing Coupling is designed around mating, spring-loaded poppet and tubular valves. This design principle combines positive sealing action with optimum flow characteristics.

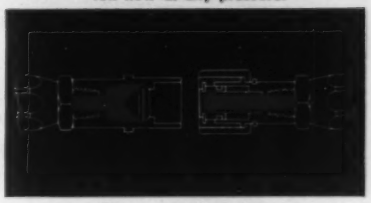
In operation, the poppet valve coupling half mates with the tubular valve coupling half, joined by a quick-threading union nut. Valves open and close simultaneously with the locking and unlocking action of the union nut. Once connected and locked, the coupling cannot unlock accidentally due to vibration and other external forces. Fluid flow through the connected coupling is accomplished with maximum safety and minimum pressure drop.

Many Types Available

No single type Self-Sealing Coupling is ideally suited for the wide range of industrial, aircraft, marine and farm applications. Aeroquip presently manufactures seven types (shown at left) to meet the requirements of varied fluid system use.

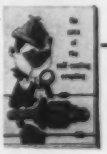


Connected coupling—full flow at any pressure.



Disconnected coupling—halves seal at any pressure.

Full information is available. Fill in and mail the coupon below for your copy of "The Case of the Self-Sealing Coupling" plus engineering bulletins on the coupling types to fit your fluid system needs. See our catalog pages in Sweet's Product Design File, Section 6d.



Aeroquip Corporation,
Jackson, Michigan

Please send me a copy of "The Case of the Self-Sealing Coupling", plus the Self-Sealing Coupling engineering bulletins check below:

- ☐ Bul. 165 on Industrial type
- ☐ AEB-14 on Aircraft type
- ☐ IEB-10 on Freon type
- ☐ IEB-11 on LP-Gas type
- ☐ REB-1 on Railroad Diesel Fueling type
- ☐ Bul. 165 on Farm type

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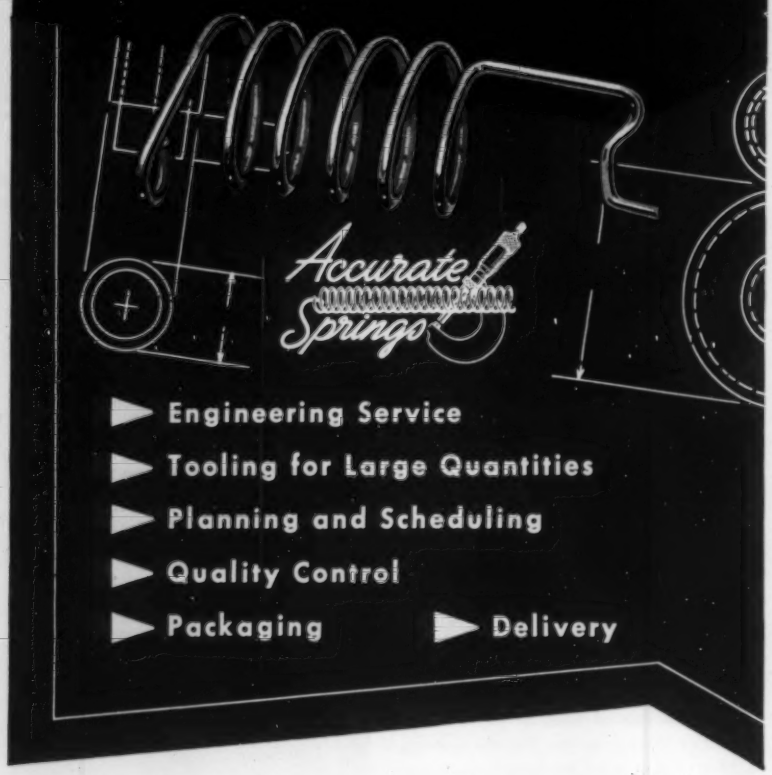
Circle 538 on page 19

Design for a Successful Spring



These are the basic elements necessary to design and produce a precision built spring. To supply the above elements takes skill, experience and imagination . . . ingredients that Accurate Spring provides every one of their customers every day.

Accurate makes millions of springs a month—precision springs held to close tolerances by rigid quality control and inspection. Production schedules for large quantities are planned well in advance. Customers are assured of deliveries scheduled to their needs.

Proper packaging is necessary too, for ease of handling and speeded production. Untangling springs can be irksome and expensive.

Accurate has a blueprint for successful spring design and quantity production. When you plan springs, plan with Accurate Spring Mfg. Co.

Accurate Springs

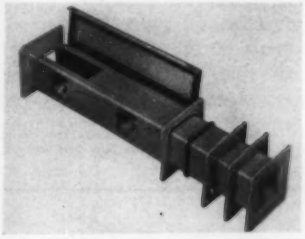
SPRINGS
WIRE FORMS
STAMPINGS

ACCURATE SPRING MFG. CO., 3824 W. Lake St., Chicago 24, Ill.

Please direct inquiries to advertiser, mentioning MACHINE DESIGN

New Parts

ed to proper length, O-ring gasket and two sliding retainer plates are bolted to the end flange of the straight section, forming an oil-



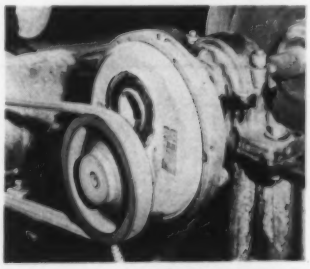
tight junction. Telescoping section for each of the three wireway sizes is 15½ in. long, and permits adjusting length of an assembly between 1½ and 13½ in. It is of 14-gage steel; welded end flange and two sliding sleeves are 11-gage steel. **Hoffman Engineering Corp.**, 1831 Tyler St., Anoka, Minn.

Circle 865 on page 19

Speed Reducers

provide speeds from 60 to 350 rpm

Four Shaft-King 5:1 ratio speed reducers use fixed or adjustable-speed belt drives to provide a speed



range from 60 to 350 rpm. They handle loads to 25 hp, and accommodate shafts to 2 15/16 in. in diameter. All reducers have standard adjustable-torque arms. **American Pulley Co.**, 4200 Wissahickon Ave., Philadelphia 29, Pa.

Circle 866 on page 19

Thyrite Resistor

for direct installation in electrical circuits

New 3-in. diameter disk-type discharge varistor assembly, designated 9RV3A, is available for direct installation in electrical circuits. Resistor is manufactured as a fam-

ily of ready-mounted groups of 1 to 4 varistors, connected in series or in parallel. The disks, in thicknesses from 0.080 to 0.375-in., are

bracket-mounted on a horizontal insulated bolt with spring-lock washer to provide contact pressure. Units are suitable for applications where space requirements are at a premium. **General Electric Co.**, Magnetic Materials Section, Edmore, Mich.

Circle 867 on page 19

Sight Glass

checks condition of refrigerant liquid

Sight glass, designated the Hermetic Eye, is a double-port type made from a one-piece forging. It has no joints, soldered parts,

springs, gaskets or fittings. Into the two ports is fused a heat-resistant, high tensile strength glass. Seal is hermetic and bond is permanent. Unit has been successfully tested at pressures of over 3000 psi. **Superior Valve & Fittings Co.**, 1509 W. Liberty Ave., Pittsburgh 26, Pa.

Circle 868 on page 19

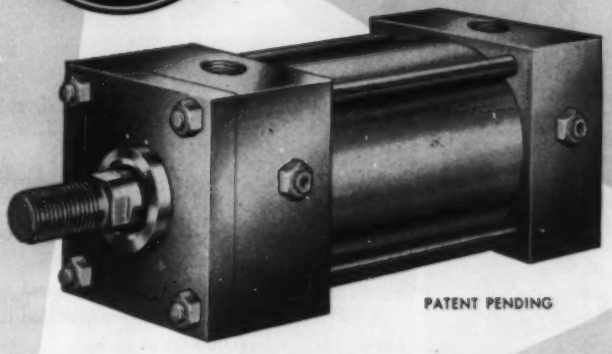
Temperature Probes

for aircraft and missile applications

Models 108, 110 and 119 temperature probes use thermistors as temperature sensing elements for use in aircraft and missiles. Nominal resistance at 25 C is 1000 ohms to ½-megohm or more. Re-

FOR AUTOMATION

SP CYLINDERS



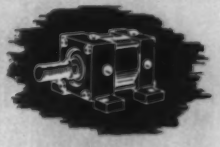
PATENT PENDING

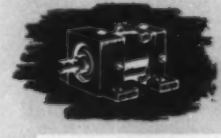
top performance–longest life

All S-P cylinders are engineered throughout for high speed, efficient operation. Piston rods are heat treated and hard chrome plated to resist scoring. Bronze cartridges with extra long bearing surfaces are easily removable for quick servicing of rod seals and wipers. End plates are rolled steel. All S-P cylinders are built to JIC standards.

S-P STANDARD AIR CYLINDERS have brass tubes to eliminate corrosion. Cushions float on O-rings for maximum cushioning. Eleven bore sizes, 1½" — 14". 21 mounting types. Readily modified for oil or water. Send for Catalog No. 110.

S-P HEAVY DUTY AIR CYLINDERS for automation and other severe applications. Double porting for extreme high speeds. Heavy wall seamless steel tube. Nine bore sizes, 1½" — 8". Five mounting types. Approved and used by two major automobile manufacturers. Send for Catalog No. 109-A.





S-P HIGH PRESSURE HYDRAULIC CYLINDERS have seamless steel tube. Special locking mechanism eliminates tie rods. Designed for 2,000 psi. Eleven models in 11 sizes. Send for Catalog No. 104.

Step up production with S-P cylinders. Representatives in principal cities. Prompt deliveries. Order catalog by number shown above. The S-P Manufacturing Corporation, 30201 Aurora Rd., Solon, Ohio. *In greater Cleveland.*

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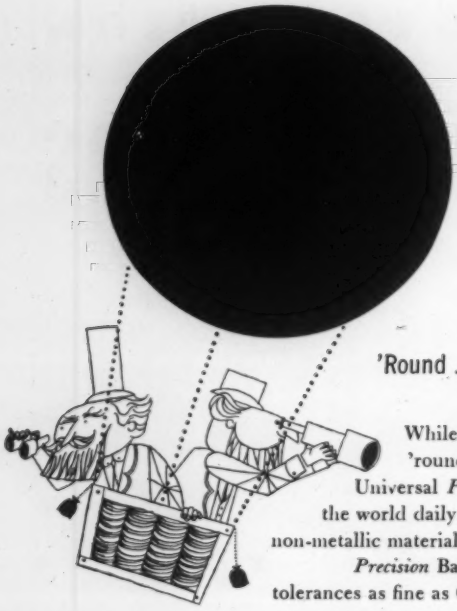
NON ROTATING AIR AND HYDRAULIC CYLINDERS • ROTATING AIR AND HYDRAULIC CYLINDERS POWER CHUCKS • COLLET AND DRILL PRESS CHUCKS • AIR PISTONS, VALVES, ACCESSORIES

Circle 539 on page 19



'Round . . . in less than 80 days!

While Jules Verne sent Phileas Fogg 'round the world in 80 days, Universal *Precision* Balls are found 'round the world daily. Whether metallic or non-metallic materials are specified, Universal *Precision* Balls are quality controlled to tolerances as fine as 0.000005 of an inch.

Round? Yes! If they are Universal Precision Balls.

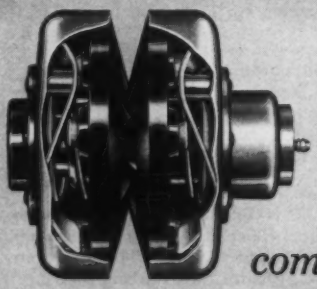
UNIVERSAL QUALITY CONTROL—FOR ALL AROUND PERFECTION

Universal Ball co.

WILLOW GROVE, MONTGOMERY CO., PA.

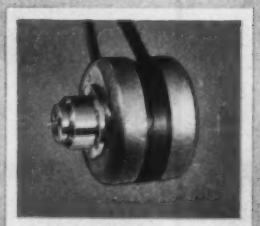
Circle 540 on page 19

DESIGN-WISE...



this simple pulley solves complicated problems

Compactness of *HI-LO* automatic variable speed pulleys simplifies basic machine design in a vast range of applications. The exclusive design of cam followers on cams provides simple, positive pitch diameter setting control. Springs in HI-LO pulleys are not driving members as in most spring-loaded pulleys, but serve primarily to keep the pulley faces in contact with the belt. Belt wear is reduced to a minimum because the belt is never under any more tension than is required by the load. Free technical manuals with diagrams, descriptions of applications and other power transmission data are available from:



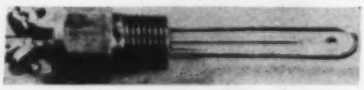
Equipment Engineering Company

2855 Columbus Ave., Minneapolis, Minnesota

Circle 541 on page 19

New Parts

sistance tolerance is ±20 per cent. Maximum operating temperature is 500 F. Probes use rigidly anchored screw terminals. Model 108 measures surface temperature;



Models 110 and 119 measure gas or liquid temperatures. Probes are fungus-resistant and survive vibration tests of MIL-E-5272, procedure 1, extended to 2000 cps. **Rosemount Engineering Co.**, Rosemount, Minn.

Circle 869 on page 19

Staked Fastener

in shoulder and flush types

Type M staked fastener provides load-bearing threads in thin, free-flowing sheet material, such as aluminum, brass, panel steels and copper. Shoulder type for maximum strength is available for panels 0.031 to 0.250-in. thick. Flush

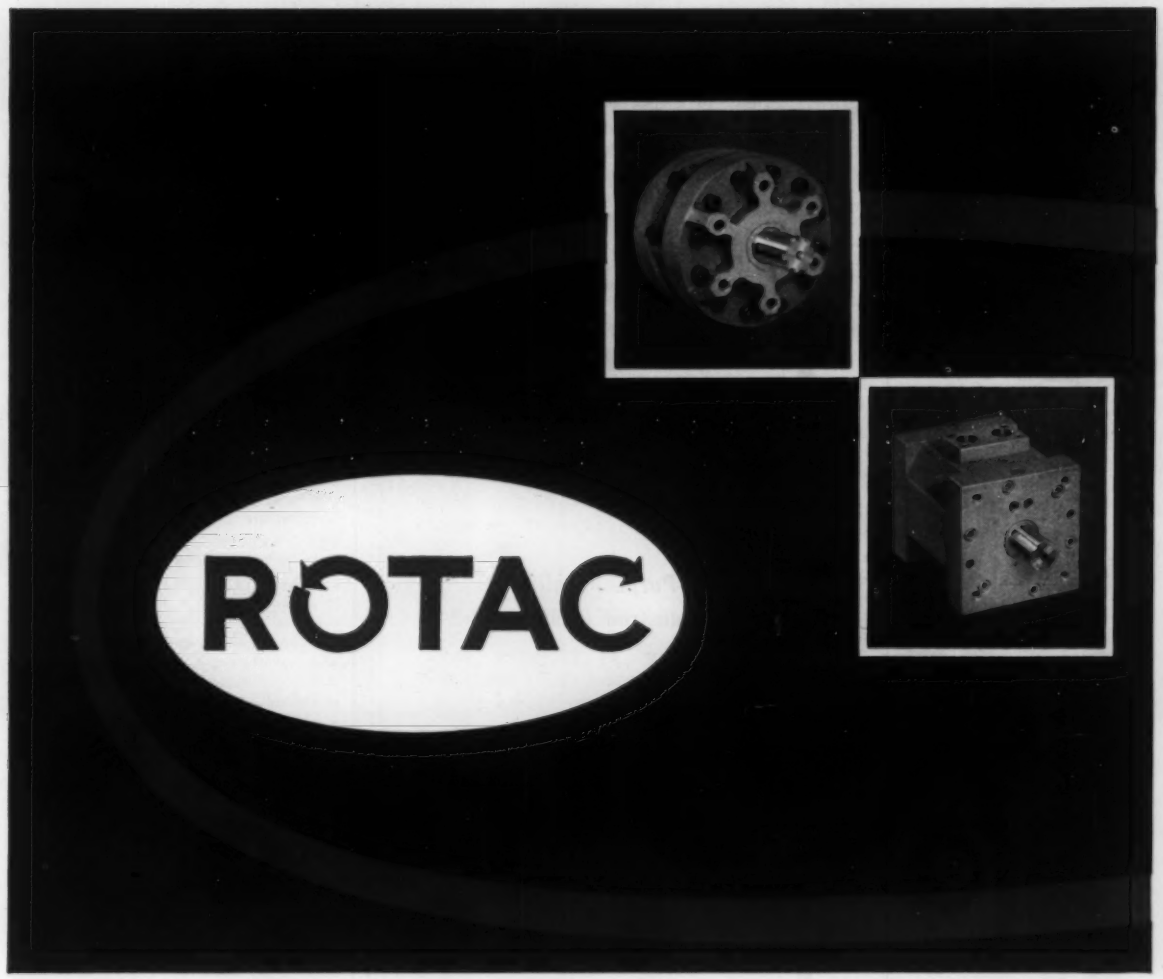
type (shown), for space economy, fits panels 0.064 to 0.250-in. thick. Gripping strength is derived from the cold flow of the panel material into the recessed, knurled grooves of the fastener during installation. Installation is by standard presses, adjustable to pressure or stroke. Fastener has wide use in the aircraft, electronics, automotive, guided missile and business machine industries. **My-T-Grip Mfg. Co. Inc.**, 176 Broadway, New York, N. Y.

Circle 870 on page 19

Diaphragm Seal

operates at temperatures to 500 F

This seal combines glass fabric with silicone rubber to provide a unit which functions within a tem-



The name is new— but you know the reputation!

Rōtac—*mark it well* because it identifies two reciprocating torque actuators you've known and relied on for years: Rotomation and Hydromotor. Now built by Ex-Cell-O, these reciprocating torque actuators do a wide variety of jobs such as clamping, indexing, lifting, revolving, pushing, pulling, lowering, swinging, closing, opening, oscillating and turning.

But more than just the name is changed.

Rōtac has undergone improvements in design, performs many jobs better than ever before. But more important, behind every Rōtac stands—not just the name—but the reputation of Ex-Cell-O. You'll recognize the familiar precision and craftsmanship that has gone into every Ex-Cell-O product for nearly forty years. You've seen it in hydraulic power units, machine tools, precision spindles, aircraft parts, bushings and Continental cutting tools made by Ex-Cell-O.

Yes, Rōtac is a new name in reciprocating torque actuators but you *know* the reputation!

Address all inquiries to:

RŌTAC DIVISION, GREENVILLE PLANT, GREENVILLE, OHIO

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MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Circle 542 on page 19

• A good chair is like a good wife...if you choose with care, it will look after your comfort and aid you in your work for a long time to come

Cramer CHAIRS ARE

GOOD CHAIRS

Scientifically planned to aid YOU in your work . . . designed to support you comfortably whether you're chewing your pencil or bent over hard at work . . . engineered from the quality materials YOU would recommend, with independently adjustable seat, back and footring to conform to your physique . . . and with removable, replaceable covers in a wide range of fabrics and colors to match YOUR decorating plan.

Pictured, Cramer Hi-Model 4D-22T with forward-tilt seat; others available. All are low-gravity balanced for safe use on casters if desired.

LIKE MORE INFORMATION?

Cramer Posture Chair Co., Inc., Dept. MD57
1205 Charlotte, Kansas City 6, Mo.

Please send me complete facts on the Cramer Hi-Model chairs designed for working architects and engineers.

Name _____

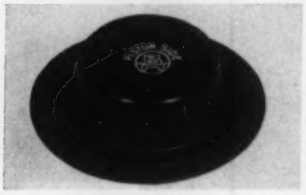
Firm _____

Address _____

Circle 543 on page 19

New Parts

perature range of −80 to 500 F. Seal is expected to be especially useful in aircraft pneumatic and fluid systems. Designs with deep convolutions and long strokes are



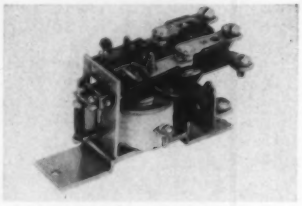
practical. One with cylinder bore dimension of 2 in., ½-in. height and 5/16-in. stroke delivered 250,000 cycles at 50 psi and 500 F. **Bellofram Corp.**, Burlington, Mass.

Circle 871 on page 19

General-Purpose Relay

for industrial applications

This relay incorporates interchangeable coils and removable multi-position base. Contacts, rated at 20 amp, 115 v, 60 cycle ac or 24 v dc, are single or dou-



ble pole, single or double throw. Relay is 2 7/16 in. high with a base measuring 1 x 3⅞ in. Choice of coil voltages and terminal connections is available. Typical applications include: motor control circuits; starter for fractional-hp motors; operation of signaling devices, pressure switches, float switches and photoelectric devices. **Wheelock Signals Inc.**, Long Branch, N. J.

Circle 872 on page 19

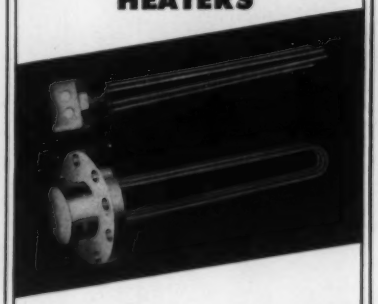
Hydraulic Actuator

for servo applications

Servotorque rotary hydraulic actuator is suitable for use in precision positional control servo systems at fluid supply pressures from 3000 to 4500 psi. Unit offers static breakaway friction of less than 1 per cent of maximum stall torque, low internal leakage and minimum

When to specify

VULCAN ELECTRIC IMMERSION HEATERS

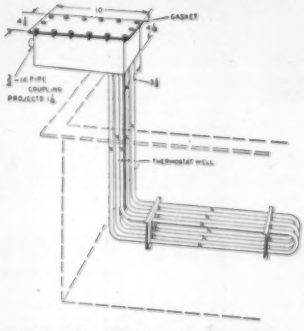


1. When application is for: Heat transfer to liquids — water, oil, wax, paraffin, asphalts, tars, solvent vapors, Dowtherm, Prestone, etc.; in tanks, boilers, urns, kettles, etc.

2. When specifications call for: Threaded bushing or flange type mounting; bayonet type, side or bottom outlet; copper, steel, stainless or alloy sheath; single or three phase; 500 to 10,000 watts; 115, 230, 460, or 550 volts; pressures up to 3500 psi.

3. When you have "hot" problems: Vulcan Engineers are ready to supply special heating units — engineered to your needs.

NEW TUBULAR TANK IMMERSION HEATERS



Vulcan's new Tubular Tank Immersion Heaters are especially recommended for use in electroplating tanks, alkali heating tanks and similar applications. Tubular elements are formed to shape as shown, and uprights are brazed into gasketed, liquid-tight terminal box.

Write for free catalog.

VULCAN

ELECTRIC COMPANY

DANVERS 6, MASS.

Cartridge • Strip • Tubular • Immersion Electric Heaters • Soldering and Branding Irons Solder and Glue Pots

Circle 544 on page 19

Problem: To produce a rugged, dependable motor case for Sunbeam Mixmasters—in sufficient quantity to meet customer's need. Production cost must be low, to keep price competitive.

Solution: Working closely with Sunbeam, Stewart Die Casting engineers developed an intricate two-cavity die, consisting of slide, cores, and one loose piece—all held to extremely close tolerances. The result was a precision casting that can be produced economically with a minimum of rejects . . . a motor case that gives dependable, long-lasting service under all conditions.

Stewart found the solution and made delivery on time!

This is just one of many complicated die castings that Stewart has developed promptly . . . and has produced in quantity *at low cost.*

Nearly half a century of experience, plus unexcelled production facilities, enables Stewart to bring you fast, practical solutions to any die casting problem.

Whatever type of die casting you need—large or small, simple or intricate—you can count on Stewart for a quality job . . . completed and delivered on schedule.

Stewart **DIE CASTING**

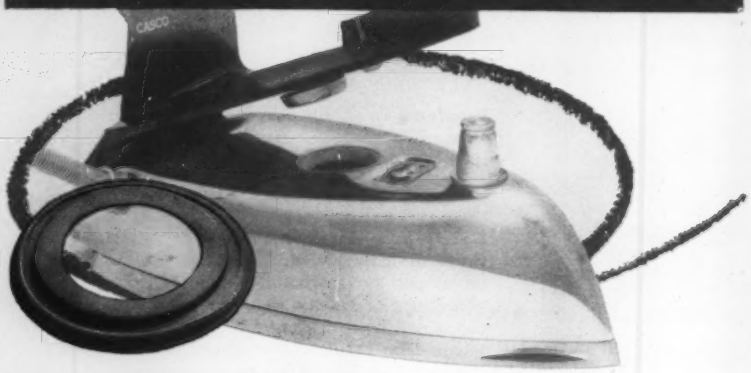
Division of STEWART-WARNER CORPORATION

Chicago, Illinois: 4535 Fullerton Avenue • Bridgeport, Connecticut: 275 Warren Street

46 YEARS OF SERVICE TO INDUSTRY

THE SHAPE OF THINGS IN MOLDED SILICONE

MOLDED SILICONE SEAL
KEEPS TAP WATER UNDER CONTROL



APPLICATION:
Funnel seal for steam and dry iron.

PROBLEM:
When this part was originally designed, Silicone rubber compounds with low shrinkage characteristics were not available. This resulted in a twofold problem; first, to produce a compound that would have excellent resistance to all types of tap water and would retain its sealing properties even if the iron were inadvertently run dry; secondly, to construct or match tooling to the characteristics of the compound.

SOLUTION:
The Acushnet laboratory chemists and tool designers working cooperatively produced a Silicone compound with a specific shrinkage rate of 5% around which tooling was finally constructed. This Silicone part, successfully molded, contributed to the safety and longer service-free life of the appliance.

Five new heat resistant and three low shrinkage Silicone compounds by Acushnet are now available for consideration in your next molded part. A complete staff of chemists and engineers offer technical assistance at any stage of design.

Send for new Acushnet Silicone Brochure

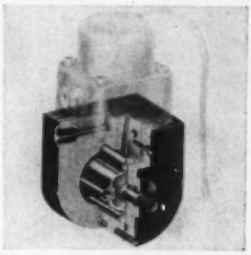
Acushnet

ACUSHNET PROCESS COMPANY
NEW BEDFORD, MASSACHUSETTS

••• *Precision Molded* RUBBER, SILICONES - "APCOTITE" BONDING
Address all communications to 762 Belleville Ave., New Bedford, Mass.

New Parts

load coupling compliance. Design configuration minimizes load induced structural distortion and permits effective sealing at both the stationary and moving vanes



despite pressure induced radial expansion of the stator. Actuator is available in sizes from 100 lb-in. to 6000 lb-in. stall torque at 3000 psi supply pressure. **Kelsey-Hayes Co.**, Aviation Div., Detroit 32, Mich.

Circle 873 on page 19

Metal O-Rings

provide pressure-tight joint at 1750 F

Toruseal Type 321 stainless-steel O-rings are available in a variety of sizes, shapes and analyses for use as seals in jet aircraft, chem-

ical processing equipment, guided missiles, atomic energy plants or wherever a pressure-tight joint is needed. Rings measure ¼-in. to 11 ft in diameter and are round or shaped. Diameter is held to ±0.005-in. on any size. Seals can be used at temperatures from −300 to 1750 F, vacuums to 0.002-micron and pressures to 10,000 psi for either liquids or gas. **D. S. D. Mfg. Co.**, 2964 Whitney Ave., Hamden, Conn.

Circle 874 on page 19

Circuit Breakers

for main or branch circuit protection

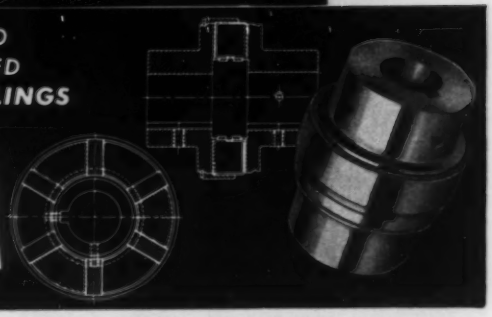
Stab-Lok double-pole units in 70 and 100-amp ratings have been added to a line of molded-case cir-

SEE this modern LOVEJOY Power Transmission Equipment

at BOOTH 113

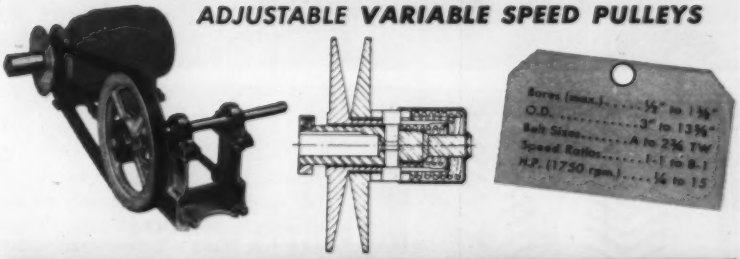
Don't Fail to Get Illustrated Bulletins Containing Full Information and Engineering Data at Booth No. 113. Yours without obligation, this literature provides a wealth of helpful information on our complete line . . . all in compact, easy-to-read, easy-to-file form.

NON-LUBRICATED EASILY-ASSEMBLED FLEXIBLE COUPLINGS



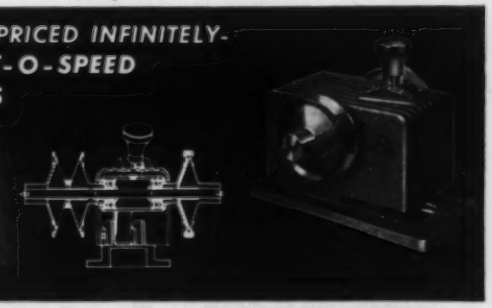
Bores (max.) . . . . . 3/16" to 9 1/2"
O.D. . . . . 5/8" to 21 1/2"
Wt. . . . . 1/2 oz. to 1500 lb.
H.P. . . . . 1/20 to 3000
Torque (static) . . 1 1/2 to 5100 ft.-lbs.

MAINTENANCE-FREE INSTANTLY-ADJUSTABLE VARIABLE SPEED PULLEYS



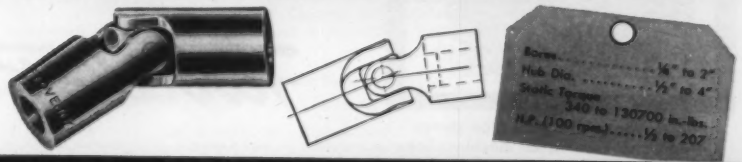
Bores (max.) . . . . . 1/2" to 1 3/8"
O.D. . . . . 3" to 13 3/8"
Belt Sizes . . . . . A to 2 3/8 TW
Speed Ratios . . . . . 1-1 to 8-1
H.P. (1750 rpm.) . . . . . 1/4 to 15

ECONOMICALLY-PRICED INFINITELY-VARIABLE SELECT-O-SPEED TRANSMISSIONS



Controls . Lever or Hand Wheel
Belt Sizes . . . . . A to C
Speed Ratios . . . . . 1-1 to 10-1
H.P. (1750 rpm.) . . . 1/2 to 7 1/2

LIGHT-WEIGHT PRECISION-BUILT UNIVERSAL JOINTS



Bores . . . . . 1/4" to 2"
Hub Dia. . . . . 1/2" to 4"
Static Torque . . . . . 340 to 130700 in.-lbs.
H.P. (100 rpm.) . . . . . 1/2 to 207

Lovejoy

First Name in Flexible Couplings

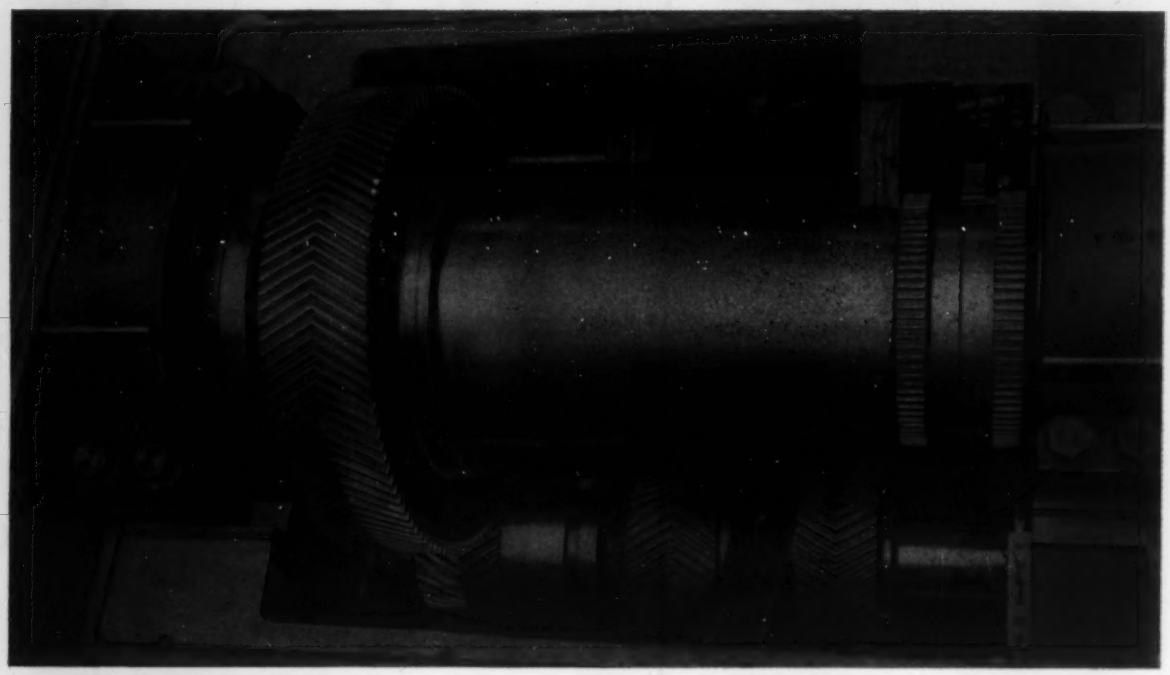
LOVEJOY FLEXIBLE COUPLING COMPANY

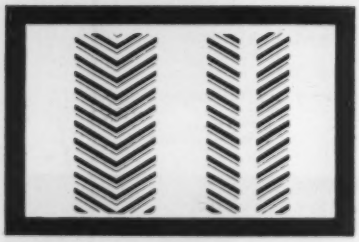
4818 WEST LAKE STREET CHICAGO 44, ILLINOIS

Circle 547 on page 19

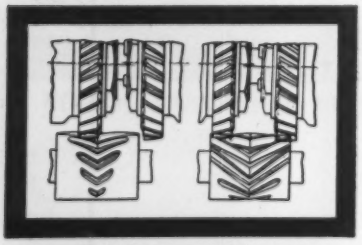
How to get and keep machine-tool precision:

design with accurate, long-lasting gears





Farrel herringbone gears have greater strength because they have greater tooth area as shown by this comparison. Left: Farrel continuous-tooth herringbone gear. Right: conventional double helical gear with center groove.



Farrel gears are precision-generated on a Farrel-Sykes machine. The two cutters reciprocate, each ending its stroke at the center of the blank. As they cut, they rotate to generate the helices and also slowly revolve in unison with the gear blank to generate the tooth contours precisely.

Include Farrel® continuous-tooth herringbone gears in your design — and you have a better machine tool to show for it. That's because these gears have the accuracy and durability so essential for precision machining.

The Farrel-Sykes method of gear generation assures extreme accuracy of tooth spacing, contour and helix angle. This pays off in smooth, uniform power flow.

What's more, the *backbone* in Farrel herringbone gears, formed by the meeting of the two helices without a center groove, puts the full face width of the gear to work. Result: Greater strength and stamina—your assurance of *sustained precision*.

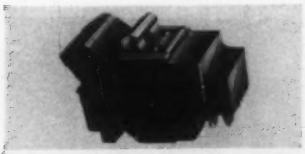
Accuracy and *backbone*—these are the reasons so many top machine designers specify Farrel gears. Send for further information.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Boston, Akron, Ann Arbor (Mich.), Chicago, Minneapolis, Fayetteville (N. C.), Los Angeles, Salt Lake City, Tulsa, Houston
European Office: Piazza della Republica 32, Milano, Italy

Farrel-Birmingham®

FB-1119



cuit breakers. The plug-in breakers are dual rated to provide both main or branch-circuit protection to convert standard load centers into main disconnect panels. Design incorporates thermal-magnetic action for rapid overload protection, automatic reset that eliminates relatching, pressure-type solderless connectors, and common trip action for two-pole disconnect when short or overload occurs through either pole. The 70-amp unit is available in connector sizes 4 through 14, and the 100-amp breaker in sizes 1 through 14. **Federal Pacific Electric Co.**, 50 Paris St., Newark 1, N. J.

Circle 875 on page 19

Aluminum Inserts

are through-threaded

Type B through-threaded aluminum inserts are used for molding in plastics, rubber and ceramics. They

are available in plain, brass-plated and clear anodized aluminum. Holes are tapped with Class 2 threads to conform to ASME specifications in thread sizes from 4-40 to ¼-28. Holes are reamed to close tolerances after tapping to facilitate placing inserts on locating pins in the dies. Both ends of inserts are countersunk for use at either end and for easy handling. Coarse outside knurl is provided for maximum holding power. **Yardley Precision Products Co.**, 30 Afton Ave., Yardley, Pa.

Circle 876 on page 19

V-Belt Clutch

pulls up to 3 hp at 3600 rpm

Improved Type AV clutch for electric motors and gasoline engines automatically adjusts for wide

SEMS BY Everlock®

HOLD TIGHTER! COST LESS!

Ever hear someone say "they don't make 'em like they used to"? Well, it's a good thing they don't! Modern autos, for instance, last up to three times as long as the cars of twenty years ago.

Sems by Everlock are one of the reasons. Every modern auto has a thousand and one places where Sems grip tight for the lifetime of the car. The illustration shows Sems used on a station wagon tailgate. Often used for both business and pleasure, station wagons get abuse and vibration that are sure to work old-time fasteners loose. But, Sems by Everlock actually hold tighter the more you try to shake 'em loose.

Here's Why You Should Order SEMS by Everlock . . .

1. **Cut costs** by eliminating separate handling of screw and washer.
2. **Simplify ordering** by reducing the number of items carried and quantities stocked.
3. **Eliminate waste** due to lost lock washers.
4. **Eliminate rejects** due to omitted lock washers.
5. **Fast delivery** on a wide range of sizes, types and finishes.

Everlock Sems are available in a wide range of types and sizes. Ordering "Sems" is not enough, only Everlock Sems, preassembled lock washers and screws, have the exclusive, full chisel edge locking action.

Other Everlock fasteners that feature the exclusive full chisel edge locking action include **Free Lock Washers, Locknuts** and **Terminals.**

THOMPSON-BREMER & CO.
Dept. L-520 N. Dearborn Street • Chicago 10, Illinois
Subsidiary of AMERICAN MACHINE & FOUNDRY CO.

WRITE FOR FREE CATALOG . . .

Another AMF Product
Everlock
INDUSTRIAL FASTENERS

Check the Alphabetical Listing in Your Telephone Book:

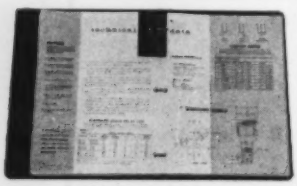
EVERLOCK REPRESENTATIVES

J. J. McIntosh, Atlanta, Georgia
C. L. Martin Sales Corp., Baldwinsville, N. Y.
Richard C. Dudek, Beverly Hills, Calif.
W. L. Barth, Jr., Chicago, Illinois
Scott & Steffen, Inc., Cleveland, Ohio
Kenneth D. Delanoy, Dayton, Ohio
Sam T. Keller Co., Detroit, Michigan
C. W. McNeil, Inc., Houston, Texas
D. G. Teeling Co., Indianapolis, Ind.
James E. Cleary, Marblehead, Mass.
Thom Lundeen, Moline, Illinois
J. Ramsey Reese, Inc., New York, N. Y.
Hank Workman, Pleasure Ridge, Ky.
W. Henry Cordray Sales Co., Philadelphia, Pa.
Oregon Indust. Factors, Portland, Oregon
Howard N. Clark, Rochester, N. Y.
Forrest Moschner, St. Louis, Mo.

Circle 549 on page 19

Write for the complete new **ENGINEERING BULLETINS—**

PHILLIPS RELAYS



IN PERMANENT BINDER

Ready for your reference files now —latest set of Phillips Relay engineering bulletins in durable ring binder. Easy-to-read, comprehensive folders provide relay characteristics, features, dimensional drawings and stock listings. Additional folders will be sent you as available. Start your own relay file today.

PHILLIPS CONTROL CORPORATION • 59 W. Washington St., Joliet 2, Ill.

Circle 550 on page 19

AQ* ------CUTS SHORT RUN STAMPING COSTS--------

PROBLEM:

Relay Support Bracket with
9 holes—two different sizes
Tolerance—hole dia. + .002/— .001; location ± .003
Blank size (developed)—1¼" x 3"
Material—.062 C. R. Strip Steel

RELAY BRACKET HOLE PUNCHING ANALYSIS

CONVENTIONAL	Single Hole "Short Run" jig punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	$125.00 $102.00
CONVENTIONAL	"Permanent Gang Die" Punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	$266.00 $11.00
FEDERAL	"Multiple Hole Process" Punching Tools and first 1,000 pieces Subsequent re-runs 1,000 pieces	$70.00 $41.00

In analyzing the problem it was found that only through Federal's multiple hole-punching process could stamping costs be cut and still hold to rigid tolerances. Let Federal quote on your next *problem piece* and save!

*Analyzed Quotation

Federal TOOL & MFG. CO.

Quality Stampings in Small Quantities

3630 Alabama Ave., Minneapolis 16, Minn.

SEE... *our* **COLOR FILM** On Short Run Stampings

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BOOTH **1523** DURING **THE DESIGN Engineering SHOW**

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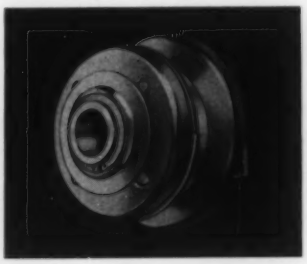
MAY 20-23

New Parts



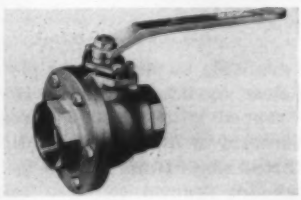
variations in belt tension and permits latitude in pulley centering. It pulls up to 3 hp at 3600 rpm. Disengaging speeds are lower than engaging speeds, and the speed differential permits high - speed take-off at maximum torque with full torque at reduced speeds. Clutch weighs 13 oz, has pulley diameter of 2¾ in., and is available with ½, ⅝ or ¾-in. bore. **Rev-O-Loc Clutch Corp.**, P. O. Box 1806, Milwaukee 1, Wis.

Circle 877 on page 19

Ball Valve

has Teflon seals and trim

Type 316 stainless-steel ball valve has low-pressure sealing, is easy to operate, and can be repacked without removal from the line. Handle can be put on in eight different positions. Corrosionproof, the



unit has full round flow and opens and closes with a quarter-turn. It is available in ⅜ to 2-in. sizes, and has Teflon seals and trim. **Rockwood Sprinkler Co.**, 38 Harlow St., Worcester 5, Mass.

Circle 878 on page 19

Frequency Meter

has 0.1 per cent accuracy for 120 v source

Consisting of a 3-in. D'Arsonval galvanometer and a case containing potted circuit components, meter offers frequency accuracy to withstand 0.1 per cent for a 120 v ±35 per cent source at a constant

HOW MUCH A POUND DID YOU PAY FOR THE HOLE?

NOT ONLY FOR THE METAL ALONE BUT ALSO IN UNNECESSARY MACHINING TO MAKE THE PART YOU NEED

You don't buy "waste-metal" and lost time when you specify *ESCO* Spuncast®—the centrifugally cast alloy steel with the built-in hole.

ESCO Spuncast is a homogeneous, pressure formed metal tube possessing chemical balances free from flow lines, forging or rolling stresses. A non-directional metal structure, available in many superior alloys, in sizes, grades and quantities not practical for large scale rolling mill production.

ESCO Spuncast is the new basic material for the mass machining of duplicate cylindrical parts. Available in sizes up to 36" O.D., lengths to 16 feet and in wall thicknesses from ¼" in suitable corrosion, heat and abrasion-resistant alloys.

See your ESCO Dealer. Ask for ESCO Catalog No. 184.

ESCO®

ELECTRIC STEEL FOUNDRY COMPANY

2183 N. W. 25TH AVE. • PORTLAND 10, OREGON

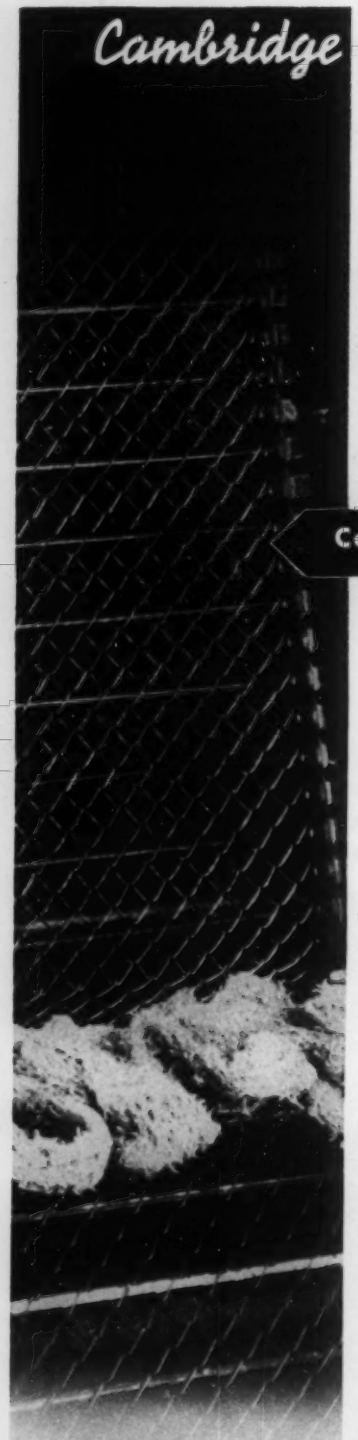
MFG. PLANTS AT PORTLAND, ORE. AND DANVILLE, ILL.

Offices in Most Principal Cities

ESCO INTERNATIONAL, NEW YORK, N. Y.

IN CANADA ESCO LIMITED

Circle 552 on page 19



Cambridge **WOVEN WIRE BELTS**
combine movement with processing to lower costs

Regardless of what you process . . . metal parts, food products, chemicals, plastics, ceramics or glass . . . a continuous belt-to-belt flow on woven wire conveyor belts combines movement with processing to eliminate batch handling and cut operating costs. Controlled speeds through any type of manufacturing process . . . hot or cold, wet or dry . . . increase product uniformity and help maintain capacity production. EXAMPLE:

Continuous Drying

MOVING BELTS carry fibres through drying oven in steady, continuous operation.

OPEN MESH allows free circulation of heat or process atmospheres around all parts of product. In washing or chemical treating operations, open mesh permits quick drainage of process solutions, uniform treatment of material.

ALL METAL BELT easily withstands temperatures from sub-zero up to 2100°F.; rust-proof alloys can be used for operation in corrosive conditions.

WOVEN WIRE CONSTRUCTION provides extra strength, extra long life. There are no seams, lacers or fasteners to break or wear.

SPECIAL RAISED EDGES or surface attachments are available to hold even smallest parts in position on the belt during flat or inclined movement.

Regardless of your industry . . . metal working, food, chemical, glass or ceramics . . . you'll find combined movement and processing practical and economical in machines for your own operation or for resale. Cambridge Woven Wire Conveyor Belts are made in any size, mesh or weave, from any metal or alloy to do the job you want . . . hot or cold, wet or dry. Call your Cambridge Field Engineer to discuss how you can cut operating costs with woven wire conveyor belts. Look under "Belting, Mechanical" in the *Yellow Pages*. Or, write for FREE 130-PAGE REFERENCE MANUAL.

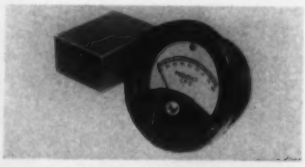
The Cambridge Wire Cloth Co.

WIRE CLOTH | WOVEN WIRE CONVEYOR BELTS | WIRE CLOTH FABRICATIONS

Department N, Cambridge 5, Maryland

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

New Parts



ambient temperature. Unit is available in four models with frequencies from 50 ±2 cps to 400 ±20 cps. **American Machine & Foundry Co.**, Defense Products Group, 1025 N. Royal St., Alexandria, Va.

Circle 879 on page 19

Urea Formaldehyde Resin

for white industrial baking enamel

Uformite F-222 for white baking enamel formulations offers improved gloss with accelerated baking speed, improved hardness, adhesion to nondrying alkyds, and resistance to food stains and water. Enamels made with the resin are well adapted for use on kitchen cabinets, refrigerators, hospital equipment and steel furniture. Physical constants of the material are: solids, 50 per cent; Butanol, 30 per cent; and Xylol, 20 per cent. Acid number is 14-18, and material is colorless and clear. **Rohm & Haas Co.**, Resinous Products Div., Washington Square, Philadelphia 5, Pa.

Circle 880 on page 19

Junction Transistor

for large-signal audio applications

Hermetically sealed alloy-junction power transistor of p-n-p type is for use in Class A single-ended and Class B push-pull at power output stages of automotive, military and commercial communications equipment. In Class A amplifier service at 55 C ambient temperature and with zero-signal collector dissipation of 5.4 w, transistor delivers maximum-signal power output of

Circle 553 on page 19

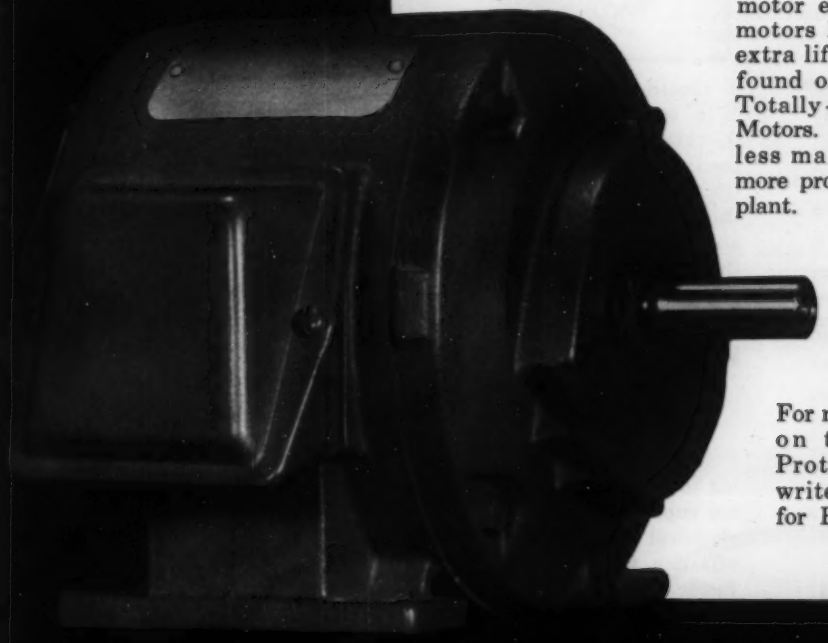
the world's only

TOTALLY-PROTECTED MOTOR

When we speak of Totally-Protected, we mean superior frame design with rigidity for heavy load conditions. We mean Metermatic bearing lubrication, acid and oil-proof insulation system, and motor leads, labeled and sealed in neoprene.

Totally-Protected means all this and more, but most of all it means a new concept of motor design and construction.

This Totally-Protected concept brings you a new motor efficiency. These motors have a built-in extra life—an extra life found only in Reliance Totally-Protected A-c. Motors. You profit from less maintenance and more production in your plant.



For more information on this Totally-Protected concept, write to Dept. 285A for Bulletin B-2401.

(B-1543)

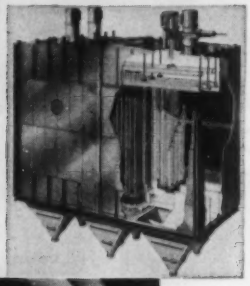
RELIANCE R ELECTRIC

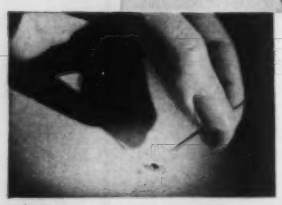
AND ENGINEERING COMPANY

CLEVELAND 17, OHIO · CANADIAN DIVISION: WELLAND, ONT.

Sales Offices and Distributors in Principal Cities

LARGE DESIGNS?





SMALL DESIGNS?

You Need the Special Advantages of Engineered Lubricants from ANDEROL

Whether you are designing a giant installation or a tiny precision bearing—a Lehigh Lubrication Specialist will be pleased to recommend a special Anderol Engineered Lubricant to meet your specific needs. Call on him while your product is still in the design stage. Regardless of volume or requirements, Lehigh will engineer a special Anderol Lubricant to do the job.

FOR MORE INFORMATION

See us at Booth No. 305-307 DESIGN ENGINEERING SHOW—May 20-23 Or Write Dept. 23

ANDEROL
ENGINEERED LUBRICANTS
Lehigh Chemical Company
CHESTERTOWN, MARYLAND

Circle 555 on page 19

New Parts

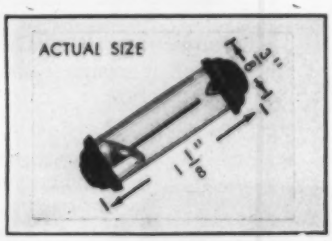
2.7 w with power gain of 32.5 db. In class B push-pull service at same temperature and with collector dissipation of 3 w, unit delivers maximum-signal power output of 12 w with power gain of 30 db. **Radio Corp. of America,** Semiconductor Div., Somerville, N. J.

Circle 881 on page 19

Mercury Switch

is small and lightweight

Hermetically sealed, tilting-type mercury switch is adaptable to applications where mounting space is limited and minimum tilt motion



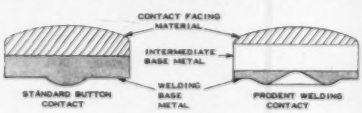
is required. It is 1⅛ in. long, ⅜-in. in diam, and is lightweight. Operation is noiseless and contact position is readily visible. Electrical rating for single-pole, single-throw unit is 1.75 amp, 115 v; 0.6 amp, 230 v. **Mercoid Corp.,** 4201 Belmont Ave., Chicago 41, Ill.

Circle 882 on page 19

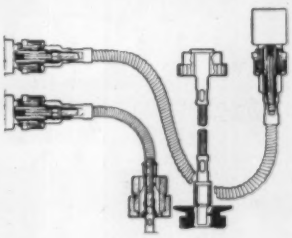
Welding Contacts

improve thermal and electrical conductivity

Prodent welding contacts, for welding to thin springs and thin mounting supports, improve thermal and electrical conductivity, and increase effective weld areas. They have facings of silver alloys, silver-cadmium oxides, precious and noble metals and their alloys, or sintered metal compositions. Clad contacts comprise a hard, wrought contacting surface and a base-metal backing. Contacts are also available in trimetal construction, consisting of a contact facing material, an inter-



Flexible Shafting For The DESIGN ENGINEER



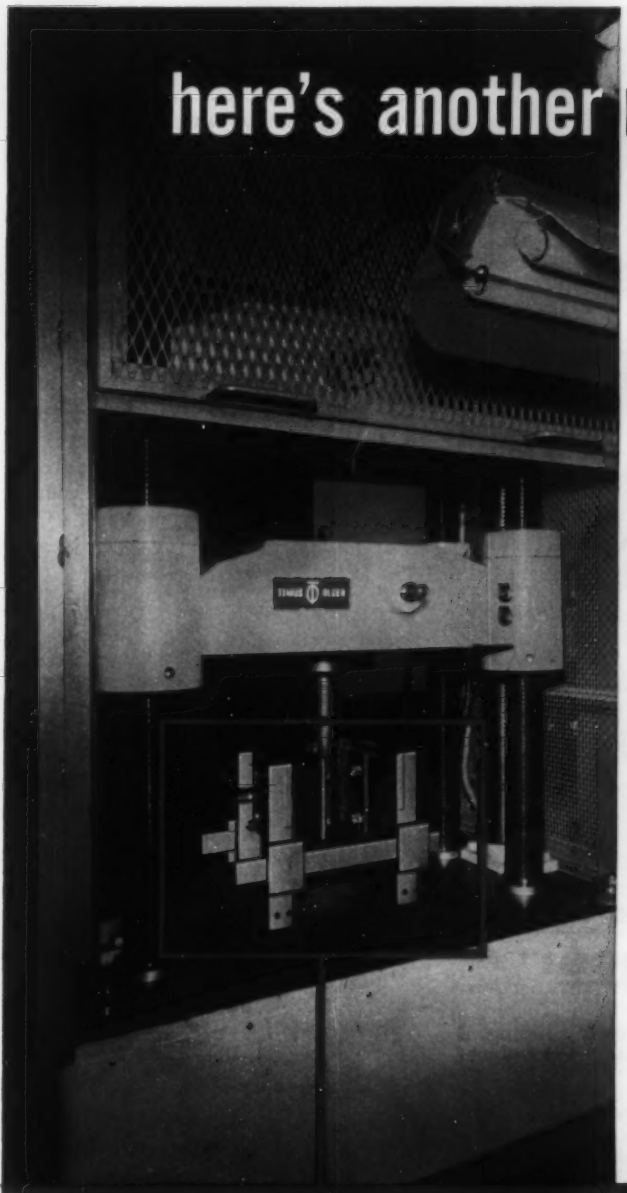
Designs may be improved or developed to their highest degree of efficiency only when the engineer is free to place his drive or driven units wherever necessary in order that he may save space, facilitate servicing, or provide for easier assembly. Flexible Shafting utilized within or in conjunction with a product enables the design engineer to reduce the number of parts, economize on space, and simplify the grouping of working units. He is able to do this because of the ability of flexible shafting to transmit power over, under, and around obstacles between the drive and driven units.

A good example of this is the above illustration. Although this diagram represents a small, compact unit, obstacles in the path of the shafts would present no serious problem to the designer. The shafts merely curve around the obstacles. When the unit is in production, none of the shafts have to be aligned; they are merely fastened to their respective units by ferrules on each of the shafts.

For complete information concerning Flexible Shafting, write on your letterhead to **F. W. Stewart Corporation,** 4311-13 Ravenswood Avenue, Chicago 13, Illinois.

Circle 556 on page 19

here's another LORD first in development of vibration mountings



In their constant search for improved vibration control, LORD engineers are not content to rely on ordinary testing techniques to prove the physical effectiveness of their designs. That's why they use this Tinius Olsen Testing Machine to put LORD-engineered mountings through exhaustive tests that subject these parts to loads up to many times their rated capacity.

This exceptional machine is comparable to one in the United States Bureau of Standards. It is electro-mechanical with variable speed drive, has a capacity of 200,000 pounds, and uses test speeds from .025 in. per min. to 10 in. per min. It provides for multiplanar tension and compression tests that prove not only the effectiveness of elastomers, but also the strength and life expectancy of bonded products.

The installation and use of this outstanding equipment is typical of LORD development efforts to provide the best in vibration control products—for the future as well as today. When your problem involves vibration control, call upon your LORD Field Engineer or the Home Office for advanced, proved engineering and vibration control products.

Unique test unit, especially designed for Lord, is used for both product development and quality control. High-precision versatility permits compression, tension and transverse loading at capacities to 200,000 pounds.

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designers and producers of bonded rubber products since 1924

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DALLAS, TEXAS - Riverside 1-3392
DAYTON, OHIO - Michigan 8871
DETROIT, MICH. - TRinity 4-2060
LOS ANGELES, CAL. - HOllywood 4-7593
NEW YORK, N. Y. - Circle 7-3326
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"In Canada—Railway & Power Engineering Corporation Limited"

LORD MANUFACTURING COMPANY • ERIE, PA.

Circle 557 on page 19

A

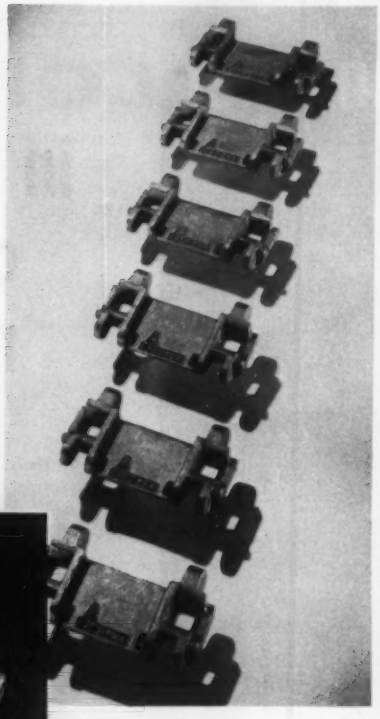
QUARTER MILLION

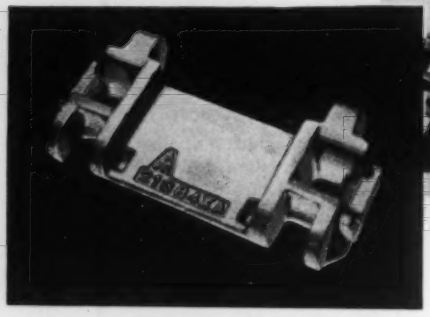
"STEPS"

IN THE

RIGHT

DIRECTION . .





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Real proof of the continuous high quality of Unitcastings is the fact that more than 99 percent of the total production of 250,000 treads has been accepted!

Continual operation in underground grit and dust subjects mining machinery treads to extreme abuse. Replacement is difficult and expensive, particularly on this section of the equipment, and parts must be made to last!

For over a decade, the abrasion-resistance quality of Unitcast's T-Loy 34 has answered this tread problem—as well as many other special parts for the same equipment.

Take a step in the right direction, too—*you'll do better with Unitcastings!* They're Engineered!

UNITCAST CORPORATION • Toledo 9, Ohio

In Canada: CANADIAN-UNITCAST STEEL, LTD., Sherbrooke, Quebec

Unitcast

SPECIFICATION STEEL CASTINGS

Circle 558 on page 19

New Parts

mediate layer of base metal, and a projection welding surface of nickel, Monel or steel. Diameters range from 0.062 to over 0.375-in. **Metals & Controls Corp.**, General Plate Div., Attleboro, Mass.

Circle 883 on page 19

Quick-Disconnect Connector

AN-type unit in wide range of sizes

Connector adapter screws over coupling threads of standard AN receptacle. External locking groove receives formed ends of coupler latch when fully engaged. Con-

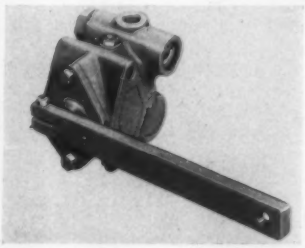
nector is locked by straight-forward movement, unlocked by pulling back sleeve. Coupler and adapter are supplied assembled on plugs and receptacles or separately. **Cannon Electric Co.**, Box 3765, Terminal Annex, Los Angeles 54, Calif.

Circle 884 on page 19

Pneumatic Valves

for air-suspension systems in vehicles

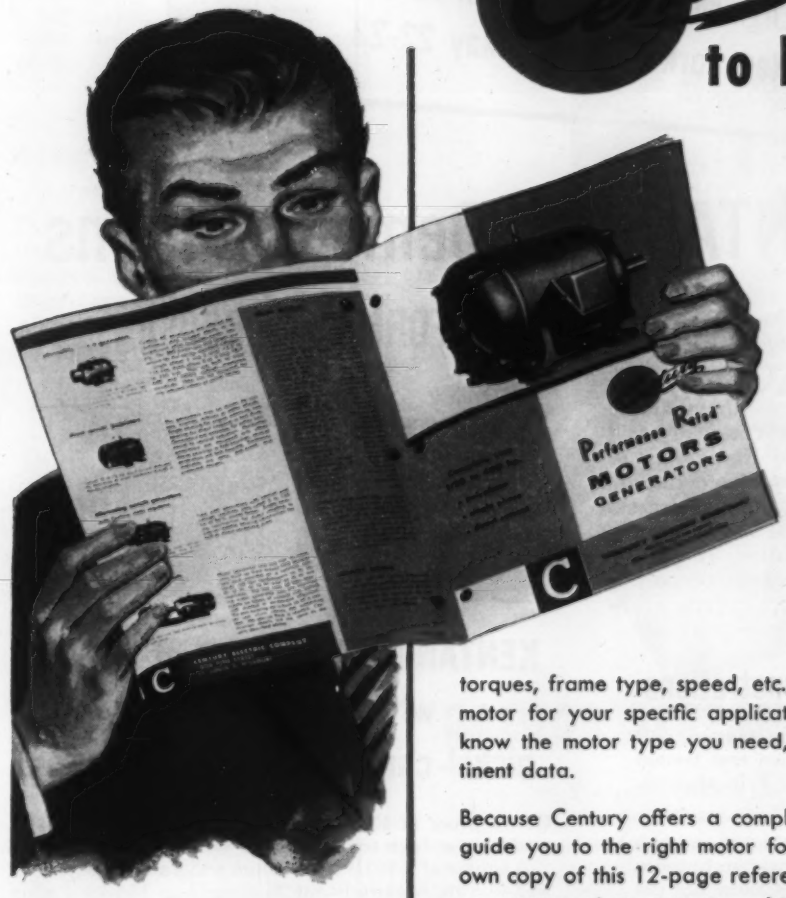
Levelator valves, used in air-suspension systems, automatically maintain the most desirable axle-



to-chassis height. Large orifices provide rapid, accurate corrections of changes in height, except for normal suspension motion caused by road irregularities. Time-delay device, adjustable to the requirements of the load, conserves air by actuating valves only after a sustained change in height. Valves

A NEW APPLICATION GUIDE

by Century to help you select Electric Motors



This handy Guide is carefully planned to make it easy for you to select electric motors for all popular applications. Using the convenient tables inside, you simply start with the equipment or machinery you want to drive.

Then, you identify the character of the load, starting and running torques, frame type, speed, etc., to arrive at precisely the right motor for your specific application. In just a few moments you know the motor type you need, the dimensions and other pertinent data.

Because Century offers a complete line, this handy manual will guide you to the right motor for your application. Obtain your own copy of this 12-page reference manual.

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Visit the KENNAMETAL* Exhibit...

Design Engineering Show, Booth 923, 2nd floor
New York Coliseum, May 22-23

See the KENTANIUM* Demonstrations

...how this titanium carbide PERFORMS at 2000°F

One of several demonstrations we will have at the Design Engineering Show in New York City will show the exceptional resistance of Kentanium to oxidation at elevated temperatures. (Note the accompanying report of a recent test.) This suggests how well Kentanium will perform at 2000°F. Come in and see this dramatic demonstration. It quickly demonstrates one of the many unique properties of Kentanium and may suggest applications where it can help you.

...see these other demonstrations

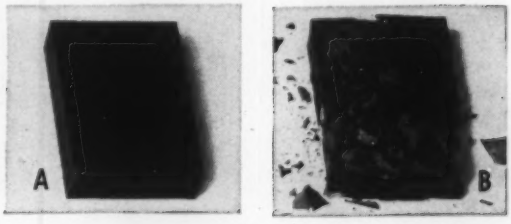
1 **THERMAL SHOCK:** Another demonstration will show the effect on Kentanium when first heated to 2000°F and then cooled to 300°F in approximately one minute. Be sure to see it.

2 **HIGH MODULUS:** This demonstration shows the high rigidity of Kentanium—approximately twice that of the hardest steel alloy. Kentanium has the highest stiffness to weight ratio of any material.

3 **WEAR-RESISTANT** properties of Kentanium while heated to a high temperature and subjected to severe wear conditions.

...and see these high purity (99.5%) metals and compounds

Columbium (Niobium)—powders, granules and bars
Columbium (Niobium) Oxide
Tantalum • Tantalum Oxide • Various Carbides



KENTANIUM unharmed at 2000°F while heat-resistant nickel-chrome alloy disintegrates

Here's proof of Kentanium's exceptional resistance to oxidation at high temperatures.

A square of K161B Kentanium and a similar square of well-known, heat-resistant 35 chromium-15 nickel alloy were exposed for 120 hours in an unsealed muffle furnace heated to 2000°F. The accompanying photographs vividly show how each piece was affected. While Kentanium (See "A") is still good for hours of exposure at high temperatures, the nickel-chrome alloy (See "B") has oxidized badly and has begun to disintegrate.

Combined with its high resistance to oxidation, Kentanium has great strength and resistance to corrosion.

These characteristics suggest how well Kentanium will perform in such applications as furnace parts, heat-treating fixtures, quench guide rings, turbine blades, nozzle vanes, bushings and other parts where strength at high temperatures, plus high resistance to oxidation, are factors.

If you do not plan to attend the Design Engineering Show, send for copies of our "Characteristics" booklet No. 111-A and "Design" booklet No. 222. Write KENNAMETAL INC., Latrobe, Pennsylvania.

C-3018B

*Trademarks

See our catalog in Section 1b/Ke, Product Design File, Sweet's Catalog

INDUSTRY AND KENNAMETAL ...Partners in Progress

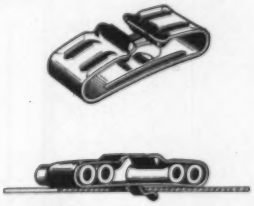
conserve vehicle air supply in the reservoir during loading and unloading when compressor is not in operation. Compressor power is available for driving, without using it for braking. **Republic Mfg. Co.**, 15655 Brookpark Rd., Cleveland 11, O.

Circle 885 on page 19

Wiring Clip

is front-mounting type

Twin U-Type Speed Clip attaches electrical wiring on household appliances, electronic equipment and other products. It is front-mounting and eliminates need for fastening devices. Electrical wires



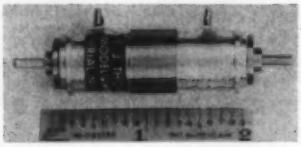
can be removed for servicing or replacement without detaching clip. Embossed ribs in the base and wire-retaining portions of clip provide rigidity and extra gripping power. Clip edges are rounded to prevent chafing and wear on wire insulation. **Tinnerman Products Inc.**, 8700 Brookpark Rd., Cleveland, O.

Circle 886 on page 19

Electromagnetic Clutch

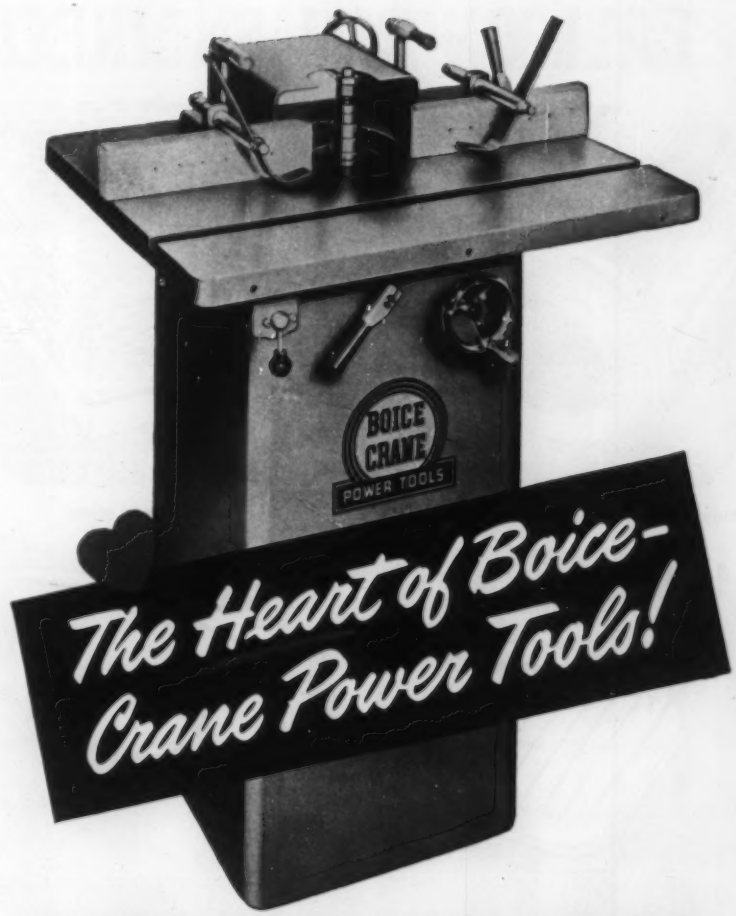
has double input with single output shaft

MCC clutch, available for electronic and instrument applications, has two input gear hubs and one output shaft. Functions of the shafts may be reversed so that a



single input can be connected to either of two outputs. Clutch is suited for use as a speed or direction changer in servo-type applications. High performance is coupled

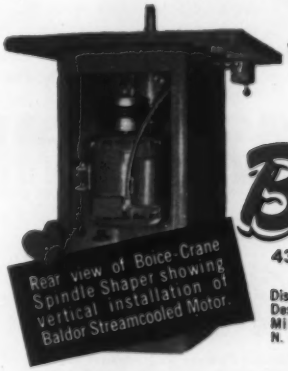
(*Continued on Page* 270)



BALDOR STREAMCOOLED MOTORS

For years famous Boice-Crane Power Tools have enjoyed a reputation for faultless performance. And for years, like hundreds of other leading manufacturers, Boice-Crane has specified and depended on Baldor Streamcooled Motors to maintain its enviable prestige.

If customers demand this kind of superior performance from *your* equipment, it will pay you to consult Baldor. Experienced engineers are available to help take the kinks out of all your knotty motor problems . . . *without obligation!*



Rear view of Boice-Crane Spindle Shaper showing vertical installation of Baldor Streamcooled Motor.

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4353 Duncan Ave. St. Louis 10, Missouri

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Circle 561 on page 19

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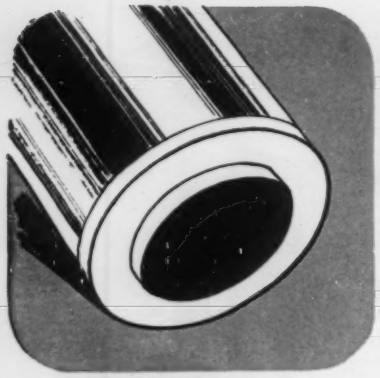
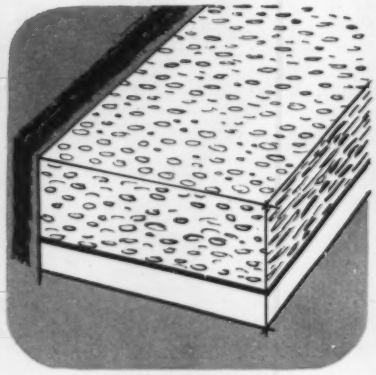
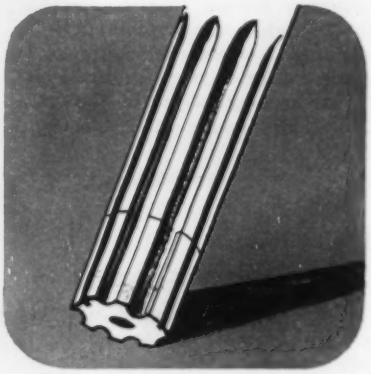


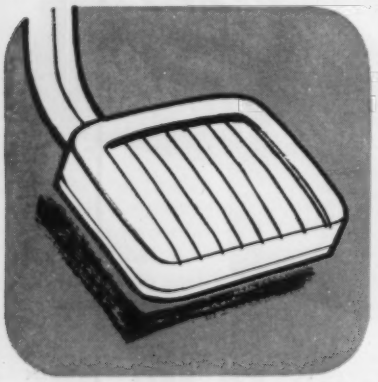
Butyl rubber foot to stainless steel tank



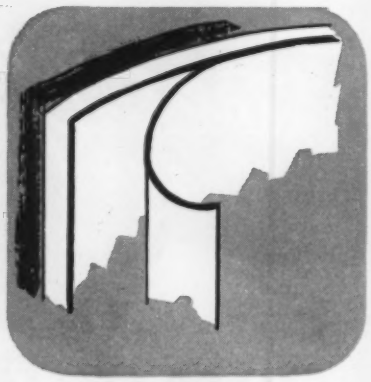
Synthetic foam to metal



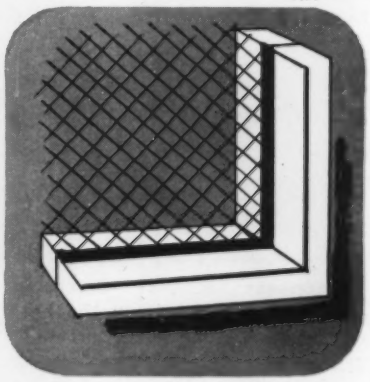
Ceramic tips to steel shanks



Natural rubber to clutch pedal



Etched "Teflon"* to steel



Rubber seals to stainless steel screens

NOW—improved production through faster and better bonding with R/M *Ray-BOND* Adhesives

FOR THESE AND COUNTLESS OTHER APPLICATIONS NEW R/M Ray-BOND ADHESIVES CAN BE TAILORED TO YOUR NEEDS

Whether or not bonding, laminating, sealing or coating are now factors in your operations, the new specialized line of R/M Ray-BOND adhesives, protective coatings, and sealers may have important advantages for you. Shown above are a few of thousands of applications where use of modern bonding techniques can simplify and improve product design and eliminate troublesome fastening problems.

*A Du Pont trademark

R/M initiated the production of bonded assemblies more than 20 years ago. Over the years we have acquired a wealth of experience that can help you cut costs and simplify operations in innumerable bonding applications. Call on our engineers to work with you in developing adhesives, protective coatings, and sealers to meet your specific requirements. Adhesives Department, RAYBESTOS-MANHATTAN, INC., Bridgeport, Conn.

Send for free copy of R/M Bulletin No. 650A, containing engineering information on Ray-BOND adhesives, protective coatings, and sealers.

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R/M FABRIC PISTON CUPS...
quality where it counts

If you want top performance in hydraulic and pneumatic applications, specify R/M Fabric Piston Cups. Here's why: precision molding produces dimensional uniformity and completely effective sealing; polymer-saturated fabric prevents internal destruction from wicking action, resists ply delamination. Furthermore, careful quality control assures consistent hardness and strict adherence to industry standard sizes.

The full R/M line includes packings and gasket sheets for use against gases, water, steam, oil, chemicals, solvents and food products. Feel free to call on R/M's specialized engineering service, if you have a problem involving any of these materials or products.

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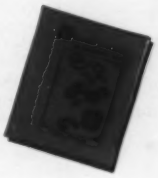
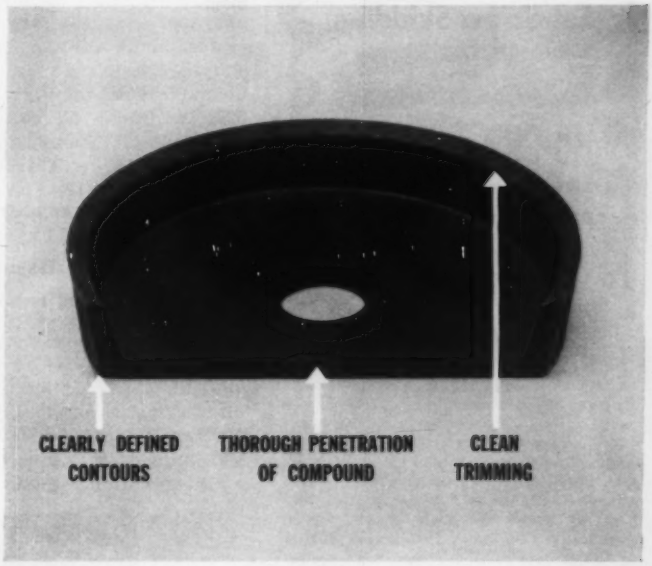
PACKING DIVISION
Raybestos-Manhattan, Inc.
Passaic, N.J.
GRegory 3-2000





R/M SUPER-POWER V-BELTS
More Power Less Space

New stretchless, super-strength synthetic cords give R/M Super-Power V-Belts extra power capacity for heavy duty drives. This means you can increase drive capacity as much as 40%... *without* changing present drive design. You can save space in *new* drive designs by using *narrower* sheaves and *fewer* belts to meet horsepower specifications! These belts have exceptional resistance to shock loads... virtually eliminate matching problems. Flat sidewalls give them better tensioning and grip, less slip... *longer* life. All-synthetic rubber makes them oilproof and heat resistant. They are also non-spark. The same advanced engineering goes into Condor-V Belts for general drive applications, into R/M Poly-V® Drives, R/M rubber hose, conveyor belt, flat transmission belt and molded or extruded parts. Let R/M specialists help you improve present equipment performance... or solve your next design problem.

*Poly-V is a registered Raybestos-Manhattan trademark.

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MANHATTAN RUBBER DIVISION
Raybestos-Manhattan, Inc.
Passaic, N.J.
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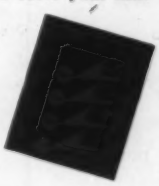

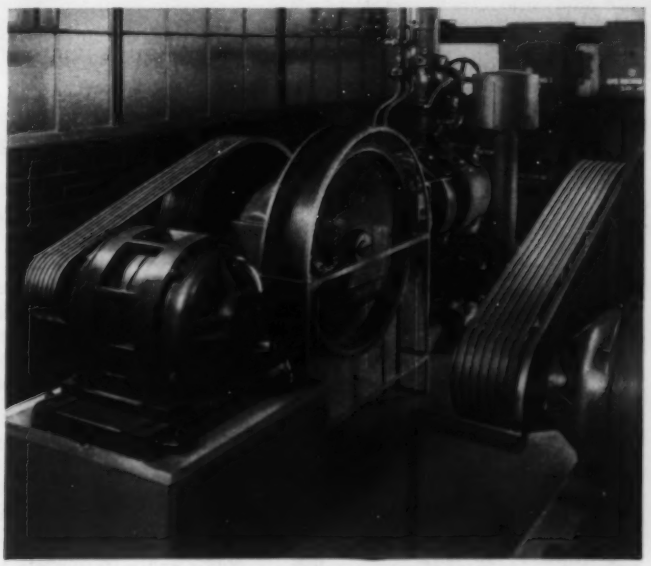

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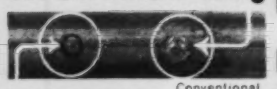
R/M

STOP

Set Screw Skidding



Conventional

NU-CUP*® gives a better bite for greater holding power on small dia. shafts!

42%

Sharper point angle

60°

Setko exclusive Nu-Cup set screws end shaft slipping on even small shafts. The sharper point... 42% sharper than conventional cups... takes a better "bite". On small shafts, this gives a full circle impression, greater resistance to reversal with the same setting torque you're now using. And, Nu-Cup set screws are made of alloy steel, specifically heat treated to make higher setting torques possible... assurance against screw head cracking.

Automation... Setko Nu-Cup set screws can be hopper-fed! The new Setko System for hopper feeding headless set screws will orient and feed Nu-Cup set screws as small as #2 (.086" x 1/8").

Available in Popular Types...

Fluted Socket | Hexagon Socket | Slotted Head | Slabbed Head

MAKE THIS NU-CUP* COMPARISON TEST... *FREE*

You're under no obligation when you test Nu-Cup's greater holding power for yourself.

Nutcracker Test Tongs with complete instructions and sample Nu-Cup set screws will be loaned on request. Setko will also send a free copy of Catalog 21 with complete details on Nu-Cup set screws, and Setko's new System for hopper feeding headless set screws.

FAST DELIVERY SERVICE...

Setko delivers even the most specialized types of set screws promptly. You get exactly what you need, when you need it!

*U. S. Pat. 2,778,265

Set Screw & Mfg. Co.

28 Main Street, Bartlett, Illinois

Circle 563 on page 19

New Parts

(Continued from Page 267)

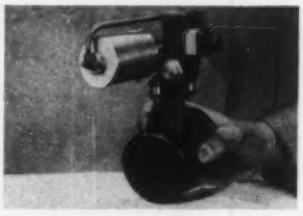
with small size, minimum weight and fast response time. Unit operates on dc voltage, and no slip rings are required. Four sizes are available with minimum torque of 3.5, 14, 26 or 52 oz. All units withstand vibrations as specified in MIL-E-5272A. **Autronics Inc.**, Route 1, Box 812, Florissant, Mo.

Circle 887 on page 19

Valve Actuator Assemblies

operate at duct temperatures of −75 to 1000 F

Assemblies are used to control the amount of hot air mixed with cold air flowing through air ducts for air conditioning aircraft. Mechanical linkage in the actuator permits operation at variable duct



pressures to 300 psi and gives maximum leverage at initial start of valve opening. Two basic types are available: On-off type, and full - modulating, variable - opening type. Valves operate at any fixed response time between 1 and 10 seconds. They operate from −75 to 1000 F, and are permanently lubricated. **Vapor Heating Corp.**, Dept. PR-57, 80 E. Jackson Blvd., Chicago 4, Ill.

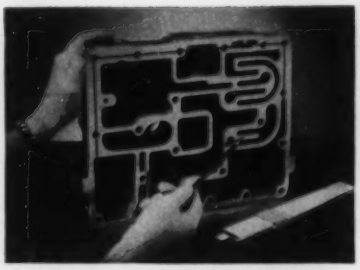
Circle 888 on page 19

Glass-Coated Capacitors

for high-temperature use

Glennite high-temperature, glass-coated ceramic capacitors permit components to operate in tempera-

ture environments to 350 F. They also provide moisture resistance, reliability of operation and good



MEEHANITE CASTINGS ARE MADE ONLY BY MEEHANITE FOUNDRIES

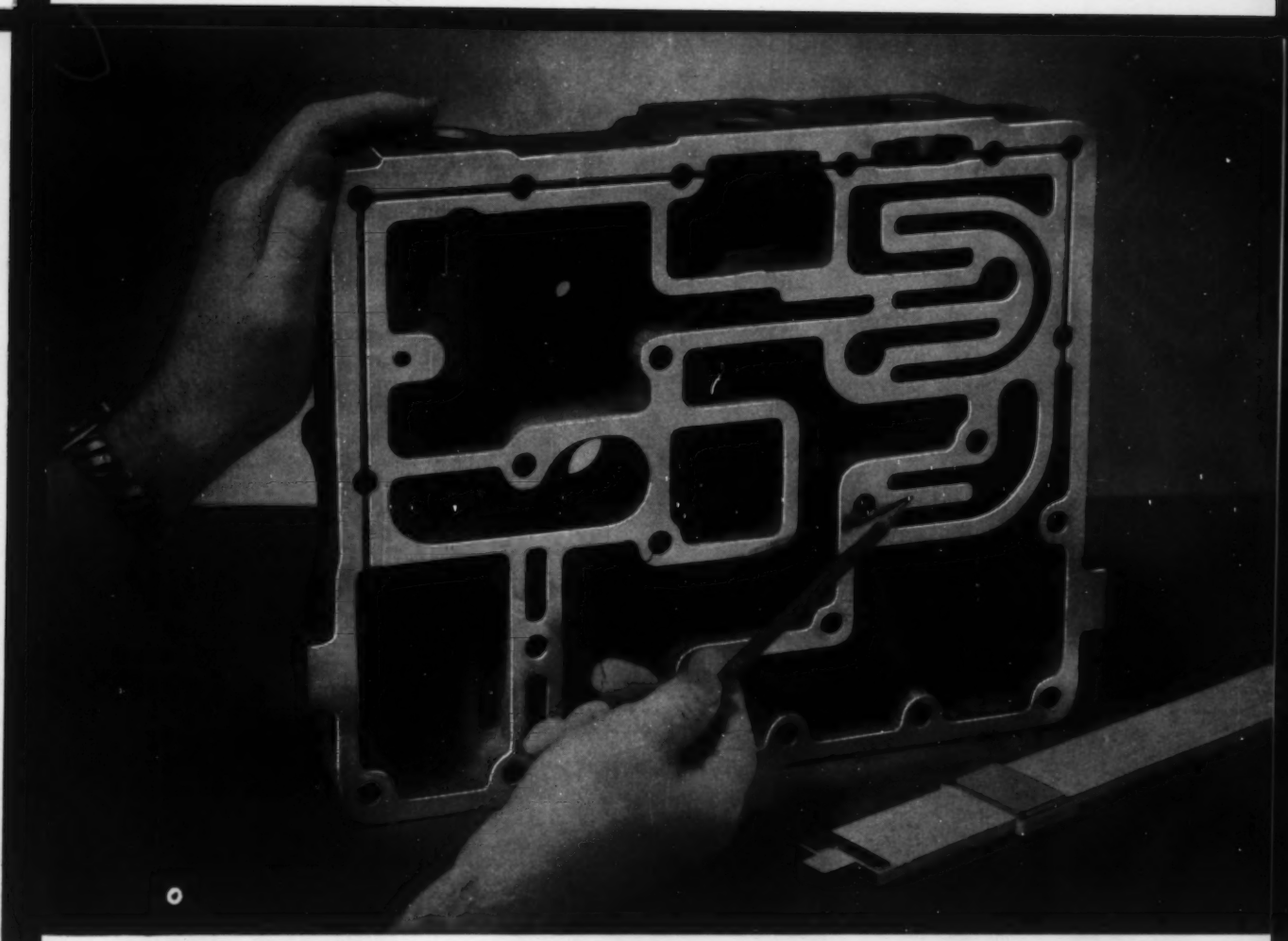
The American Laundry Machinery Co., Rochester, N. Y.
Atlas Foundry Co., Detroit, Mich.
Banner Iron Works, St. Louis, Mo.
Barnett Foundry & Machine Co., Irvington, N. J.
Blackmer Pump Co., Grand Rapids, Mich.
Centrifugally Cast Products Div., The Shenango Furnace Co., Dover, Ohio
Compton Foundry, Compton, Calif.
Continental Gin Co., Birmingham, Ala.
The Cooper-Bessemer Corp., Mt. Vernon, Ohio and Grove City, Pa.
Crawford & Doherty Foundry Co., Portland, Ore.
Empire Pattern & Foundry Co., Tulsa, Okla.
Florence Pipe Foundry & Machine Co., Florence, N. J.
Fulton Foundry & Machines Co., Inc., Cleveland, Ohio
General Foundry & Mfg. Co., Flint, Mich.
Georgia Iron Works, Augusta, Ga.
Greenlee Foundry Co., Chicago, Ill.
The Hamilton Foundry & Machine Co., Hamilton, Ohio
Hardinge Company, Inc., New York, N. Y.
Hardinge Manufacturing Co., York, Pa.
Johnstone Foundries, Inc., Grove City, Pa.
Kanawha Manufacturing Co., Charleston, W. Va.
Koehring Co., Milwaukee, Wis.
Lincoln Foundry Corp., Los Angeles, Calif.
Palmyra Foundry Co., Inc., Palmyra, N. J.
The Henry Perkins Co., Bridgewater, Mass.
Pohlman Foundry Co., Inc., Buffalo, N. Y.
The Prescott Co., Menominee, Michigan
Rosedale Foundry & Machine Co., Pittsburgh, Pa.
Ross-Meehan Foundries, Chattanooga, Tenn.
Sonith Industries, Inc., Indianapolis, Ind.
Standard Foundry Co., Worcester, Mass.
The Stearns-Roger Mfg. Co., Denver, Colo.
Valley Iron Works, Inc., St. Paul, Minn.
Vulcan Foundry Co., Oakland, Calif.
Dorr-Oliver-Long, Ltd., Orillia, Ontario
Hartley Foundry Div., London Concrete Machinery Co., Ltd., Brantford, Ontario
Otis Elevator Co., Ltd., Hamilton, Ontario

Send for your free single copy

This handy Meehanite Wheel Chart M-6 contains complete physical specifications.

Write today to Meehanite Metal Corporation, Department 4D, 714 North Avenue, New Rochelle, New York.

MEEHANITE®



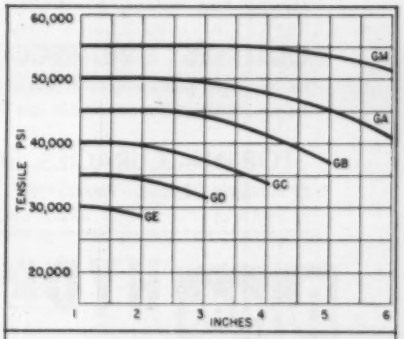
Rigidly controlled Meehanite metal assures uniform physical properties in all sections of complex castings.

This extremely complex Meehanite casting was made in large quantities for use in the production of military tanks. Every casting had to be completely free from defects in order to pass exacting inspection standards and uniformly high physical values were required, despite a number of intricate sections which varied from ¼″ to 2″ in thickness.

Meehanite metal may be poured in both heavy and light sections, minimizing the danger of draws, shrinks, openness of grain and varying physical properties. Containing a controlled quantity of graphite in a pearlitic matrix, Meehanite castings shrink 50% less than steel during solidification, hence eliminating casting strains, warping and cracking.

The uniformity and control of the microstructure of Meehanite castings results in high strength, improved wear resistance, excellent vibration damping, dimensional stability, good machinability and many other engineering advantages.

For more information write today for a free copy of the Meehanite Wheel Chart M-6 which contains complete physical specifications.



Effect of increasing casting dimension on tensile properties of Meehanite castings.

MEEHANITE BRIDGES THE GAP BETWEEN CAST IRON AND STEEL®

MEEHANITE METAL

MEEHANITE METAL CORPORATION, NEW ROCHELLE, NEW YORK

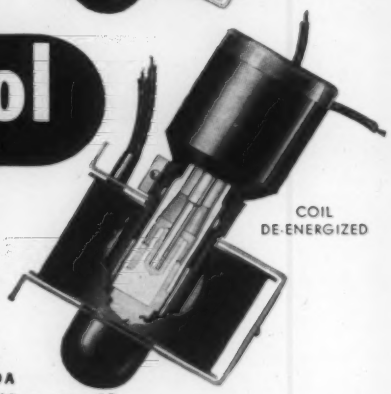
Circle 564 on page 19

The TIMER RELAY
that handles all controlled timing problems . . .

This steel clad, factory set, tamper proof Durakool timer-relay is practically non-breakable. Operating life multiplied 5 to 6 times by new plunger construction features. Combinations of operate-release time delays from 0.15 sec. to 20 sec.—either normally open or normally closed action.

Durakool
STEEL MERCURY TIMERS

★ No false contacts
★ Non sticking
★ Practically "fail safe"
★ Low cost timer



See telephone directory for local distributor, or write.

DURAKOOL, INC.
ELKHART, INDIANA, U.S.A.
700 WESTON RD., TORONTO 9, CANADA

Circle 565 on page 19

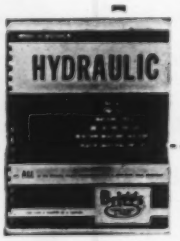
IF YOU OWN, OPERATE OR MAKE
HYDRAULIC EQUIPMENT

AT NO COST TO YOU, write for your copy of a complete filter-hydraulics manual. Shows how to get smoother, longer operation from equipment of ANY SIZE . . . large or small.

OUTLINES FIVE RECOGNIZED SYSTEMS for the most efficient use of filtered hydraulic fluids; fully covered are pro's and con's of each with diagrams.

STOP INACCURACIES, SHAFT AND PISTON CHATTERING, UNEVEN OPERATION. See how by asking for our no cost trial offer on your own equipment in your own plant.

Briggs **HYDRAULIC OIL FILTERS**



THE BRIGGS FILTRATION CO., Washington 16, D.C., Dept. 171

YES! Send me my copy of "HYDRAULICS" at no cost to me.

NAME _____
COMPANY _____
ADDRESS _____

New Parts

corona suppression. Capacitors feature a fused, nonporous layer of glass over the thin-sheet barium titanate ceramic capacitors. Pure silver leads are easily soldered and provide excellent resistance to oxidation at high temperatures. Units are available in all ranges and values of standard temperature compensating and high-compensation ceramic capacitors. **Glenco Corp.**, 212 Durham Ave., Metuchen, N. J.

Circle 889 on page 19

Pushbutton Switch

provides keyboard control of electric equipment

Pushbutton switch is for manual keyboard control of electric equipment. It is designed for rapid-repeat, one-finger operation. Switch employs a single-pole double-throw subminiature basic snap-action

switch, and can be operated at frequencies up to 300 times per minute. Removable, contoured ½-in. diameter plastic button is keyed to prevent rotation. Subminiature switch incorporated in the pushbutton switch is rated at 5 amp, 125 or 250 v ac. **Minneapolis-Honeywell Regulator Co.**, Micro Switch Div., Freeport, Ill.

Circle 890 on page 19

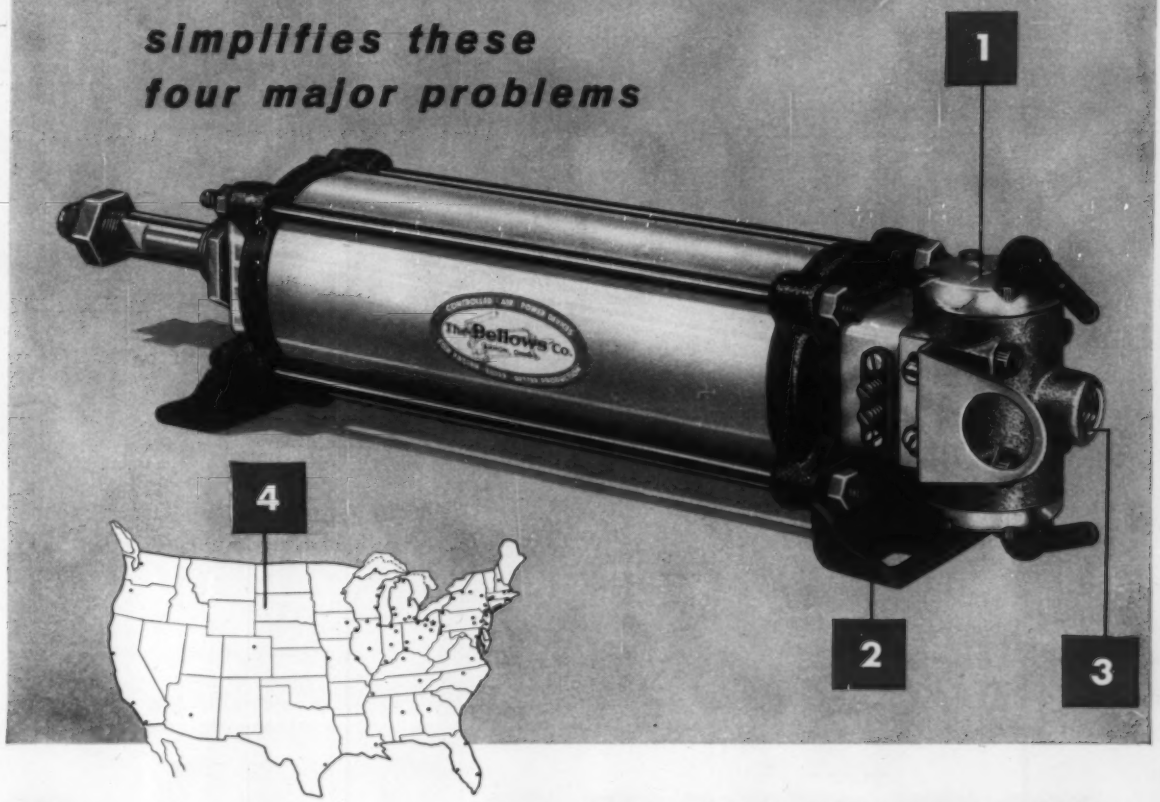
Threadless Pipe Fittings

withstand traction forces up to 3600 lb

Threadless pipe fittings are used for joining steel, wrought iron or plastic pipe. They withstand traction forces to 3600 lb and hydrostatic pressures from 450 psi on 2-in. pipe to 5000 psi on ½-in. pipe. Brass clutch ring with internal serrations provides gripping action. Fittings are available in

THE Bellows AIR MOTOR

simplifies these four major problems



1 **Built-in electrically controlled directional valve, either 8 or 110 v., simplifies design problems.**

2 **Built-in speed controls for accurate regulation of piston rod speed simplify control problems.**

3 **The single air connection, which can be made with flexible air hose, simplifies installation problems.**

4 **More than 125 Bellows Field Engineers in the United States and Canada simplify service problems.**

Design, control, installation and service are problems every O.E.M. Design Engineer faces when selecting components for automation.

In pneumatic design, the Bellows Air Motor—the air cylinder with the built-in valve—simplifies his problems. Instead of separate valving for directional control, separate valving for speed control, multiple mounting, complex and cumbersome piping for air supply—he works with one compact, complete power unit.

Not only are design and control simplified when you specify "Bellows", but installation costs are less; and you know wherever your machine is shipped, a Bellows Field Engineer will be available for service if it is ever needed.

Write for Bulletin BM-25
"The Story of The Bellows Air Motor"
Address: Dept. MD 557
The Bellows Co., Akron 9, Ohio

The Bellows Co.

AKRON 9, OHIO

In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ont.

6448

Circle 567 on page 19

Best low-cost way to incorporate variable-speed into machine designs

Choose from 8 sizes . . . ¼ to 15 hp . . . 1.75:1 to 4:1 speed ratio. Converts any standard constant-speed motor into variable speed drive.
MAXIMUM TO MINIMUM OUTPUT SPEED POSITIONS

REEVES®

Vari-Speed Motor Pulley

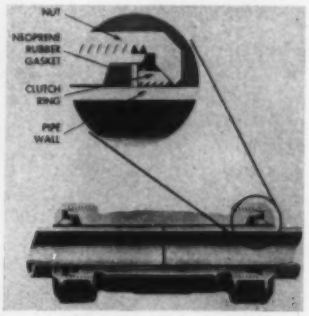
Specify this easy, economical way to efficient and versatile use of the machines you design. REEVES-equipped machines adjust immediately to a variety of production speeds, production processes . . . you substantially reduce design and capacity obsolescence.

Your REEVES representative will be glad to work with you on the application best suited to your design. Offices in principal cities—or write direct for Catalog H28cV545.

REEVES PULLEY COMPANY
Division of **RELIANCE** ELECTRIC AND ENGINEERING CO.
Columbus, Indiana

New Parts

couplings, adapters, 90-deg elbows and tees. They are of high-tensile, corrosion-resistant malleable iron,



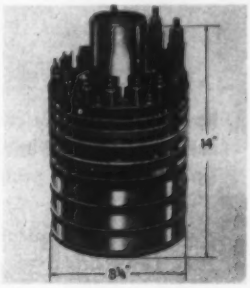
and have galvanized or phosphatized rustproof finish. **Telsco Fittings Div.,** 5422 Redfield St., Dallas, Tex.

Circle 891 on page 19

Slip Ring Assembly

accommodates segmented and continuous rings

Rotating slip ring assembly has eight rings: three bottom rings for continuous-power circuits of 230-amp capacity each, and five upper rings segmented for switching 5 to 10 amp each. All rings are in-



sulated for 440 v. Assemblies have many uses in current distribution and rotary-switch systems where automation equipment is designed for continuous manufacturing. **Superior Carbon Products Inc.,** 9115 George Ave., Cleveland 5, Ohio.

Circle 892 on page 19

Lamination Treatment

provides added insulation resistance

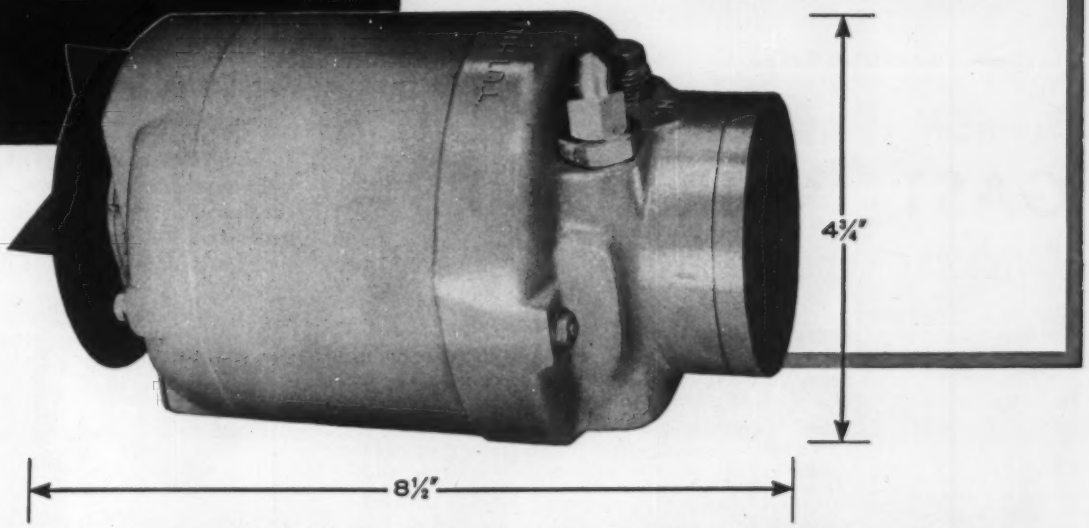
Lamox process for treatment of laminations imparts added insulation resistance while maintaining

ANOTHER PUMP PROBLEM...SOLVED BY **TUTHILL**

new POWERMITE

PUMP and MOTOR COMBINATION

• COMPACT • LIGHTWEIGHT
• ECONOMICAL



Here's another example of Tuthill's ability to develop the pump to fit the problem. This compact, new Powermite motor-pump combination, a Tuthill exclusive, was developed to meet the requirements of original equipment manufacturers with unusual space and weight limitations.

Motor and cooling blower have, in effect, been incorporated into the internal gear positive displacement rotary pump. The whole unit takes up no more space than a standard electric motor. A single shaft serves all units of the Powermite—and the elimination of couplings, other parts and labor permit substantial economies for OEM applications.

The pump section contains a built-in strainer, and, if desired, an adjustable relief valve. Powermite can be furnished with cooling blower, as illustrated, or it may be supplied with a shaft extension for driving other accessories.

Powermite can be furnished in a wide variety of pump and motor combinations for use in hydraulic, oil burning, lubricating, and other services involving many different fluids. For example, the model illustrated has a capacity of 18 gallons per hour at 300 psi, and is driven by a 1/12 hp motor at a speed of 1750 rpm.

Manufacturers desiring to investigate the cost, space and weight saving advantages of incorporating Powermites into their products are invited to submit detailed specifications. Or, if preferred, a Tuthill representative will call.

TUTHILL PUMP COMPANY
9ɔɔ East 95th Street, Chicago 19, Illinois
Gentlemen:
☐ Please have your representative call to discuss Powermite applications in my product
☐ Please send catalog describing complete Tuthill line.
NAME_____ TITLE_____
COMPANY_____
STREET_____
CITY_____ STATE_____

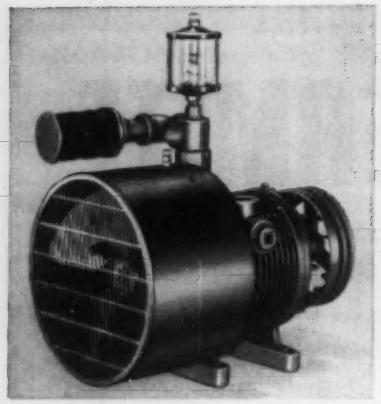
Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities from 1 to 200 GPM, for Pressures to 600 PSI, Speeds to 3600 RPM.

TUTHILL PUMP COMPANY

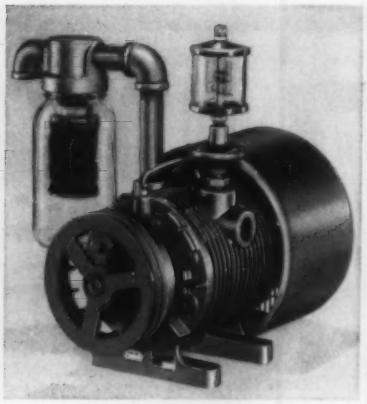
953 East 95th Street, Chicago 19, Illinois
Canadian Affiliate:
Ingersoll Machine & Tool Company, Ltd., Ingersoll, Ontario, Canada

PUMPS FOR YOUR PURPOSE

Circle 569 on page 19



Compressor Model 4565-P3 to 20 p.s.i.



Vacuum Pump Model 4565-V6 to 25" hg.

Big NEW 45 c.f.m. fan-cooled Model 4565

GAST rotary vane AIR PUMPS—

Twice the capacity of previous models!

COMPRESSOR

Delivers to 45 c.f.m., to 20 p.s.i.g. continuously with 5 h.p. motor at 1750 r.p.m. At lower pressures, 3 h.p. may be used. Includes automatic lubricator, felt type intake filter.

VACUUM PUMP

Delivers to 45 c.f.m., vacuum to 25 in. hg. with 3 h.p., 1750 r.p.m. For 35 c.f.m. at 1350 r.p.m., 2 to 3 h.p. is adequate. Has heavy-duty lubricator and exhaust muffler.

WRITE TODAY for Bulletin 557-VP with performance data.

Here's new, bigger-volume air pump utility—for original equipment or plant use! Built for continuous, heavy-duty service as either a Compressor or Vacuum Pump, the Model 4565 eliminates water-cooling headaches. It's air-cooled by a 10" diameter pitch fan enclosed by cowl-guard which directs cooling air and insures safety by covering fan mounted on shaft extension.

Long-lived, efficient 5-vane rotary design delivers a positive displacement of pulseless air. No air tank is needed on compressor.

Pump is easy to mount. Drive with double v-belts eliminates precision alignment problems, and fan on pulley adds extra cooling capacity. Heavy ball bearings, with double row on drive end. Pump weight approximately 92 lbs.

Investigate Gast Model 4565—it may solve a problem for you! Gast Manufacturing Corp., P.O. Box 117-P Benton Harbor, Michigan.

SUGGESTED APPLICATIONS

As volume source of low pressure air or vacuum, independent of plant air lines. COMPRESSOR: For air atomizing No. 5 or 6 fuel oil on burners for packaged boilers to 500 h.p., etc. VACUUM PUMP: Does the work of two smaller pumps for paper or sheet feeding to printing presses, packaging, labeling or bottle-filling machinery. Suitable for pipe-line milking machines, and for vacuum-forming large plastic sheets. Recommended for dry vacuum only.

Original Equipment Manufacturers for Over 25 Years

GAST ROTARY

- AIR MOTORS TO 4 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

SEE OUR CATALOG IN SWEET'S PRODUCT DESIGN FILE

Circle 570 on page 19

New Parts

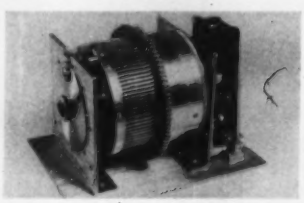
good bonding characteristics. Process reduces eddy current losses, enabling use of a smaller and more efficient stack of laminations. Uniform, continuous coating will not crack, chip, peel or flake off, and is free from scale, rust or core plate. No dimensional change from the unfinished part is produced. **Black Ox Metal Finishing Co. Inc.**, 34-11 Tenth St., Long Island City 6, N. Y.

Circle 893 on page 19

Time-Control System

controls periodic operations

Multiple time-control system controls periodic operations or sequences of operations of regular or irregular time intervals. Device controls infinite number of operat-



ing units and is readily reset to make changes or variations. Relay-controlled devices can be activated and de-energized intermittently, simultaneously, or in any desired combination. A mechanical device, unit is powered by a stock electric motor. **A. R. T. H. Inc.**, 1615 Scheffer St., St. Paul, Minn.

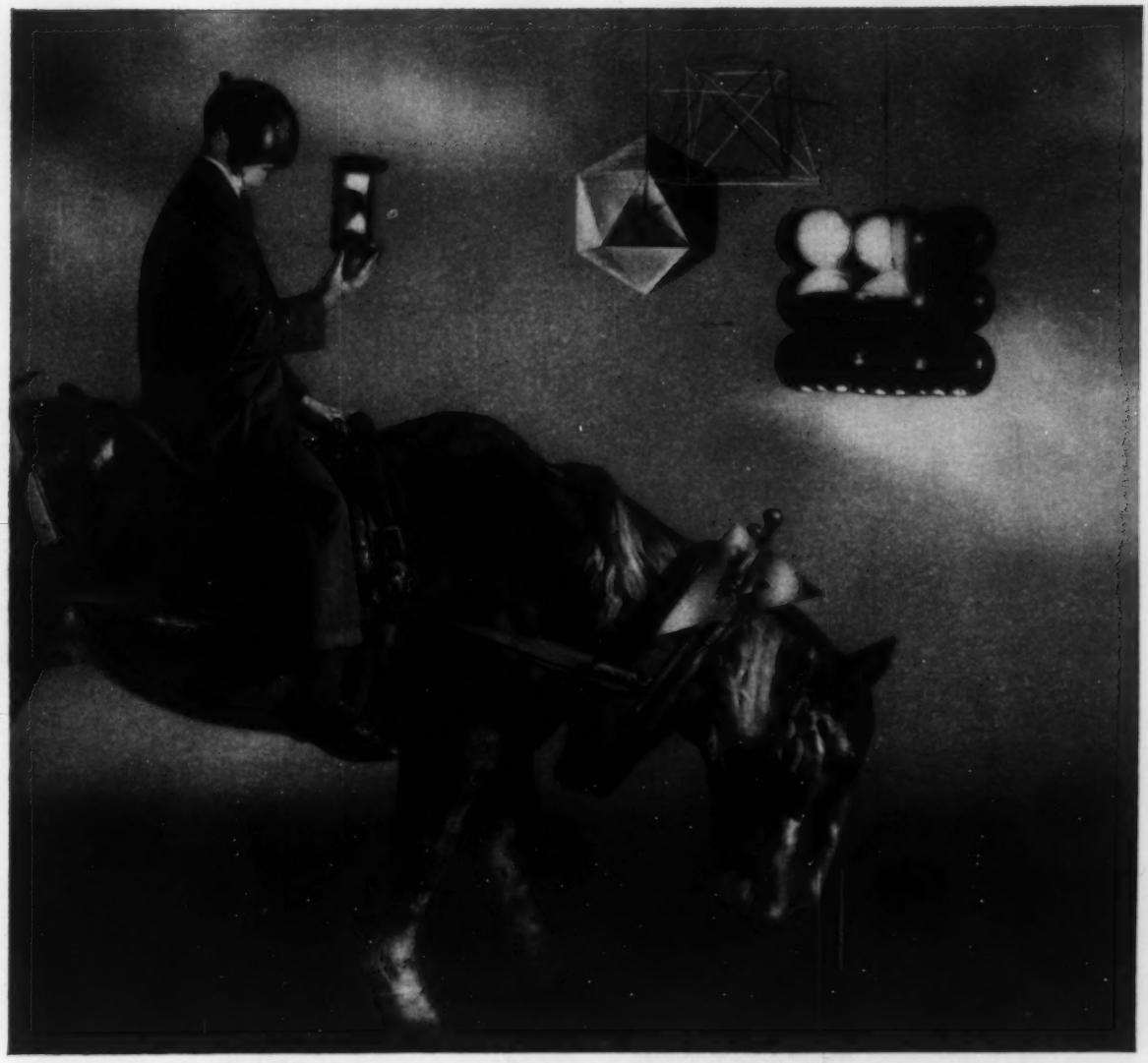
Circle 894 on page 19

Cap Nuts

provide greater thread depth

Line of die-cast zinc-alloy high-series cap nuts provides an improved means of covering exposed bolt ends of varying lengths. Cor-

rosion-resistant nuts provide up to 50 per cent greater thread depth, achieved by an increase in overall height of cap nut. Nuts are available in hex sizes from 5/16 to 5/8-



A Man Nobody Wants

Close inspection will show that the entire horse is in this picture, after all. Our mounted subject's current project is necessarily long term: he is out to prove that Univac made a mistake in contradicting one of his pet hypotheses. (It took Univac four hours to come up with its answer.)

This equestrian is so pedestrian that he would never be interested in the fancy-stepping Rogers stable.

Anyway, Rogers is devoted to serving engineers — those men who range eagerly across the face of the globe seeking someone who will breed another winner, sired by imagination out of originality.

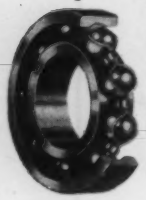
Like the big auto maker that needed a transmission gasket material that would work. Rogers developed one, without wasting oats. We invite engineers to send us their names and addresses, so we can send them some plugs that will spur their interest.

ROGERS
CORPORATION
ROGERS, CONNECTICUT

DUROIDS—for Gaskets, Filters, Electronic Devices, Thermal Insulation, etc. ELECTRICAL INSULATION—for Motors, Transformers, Generators, etc.
SHOE MATERIALS—for Counters, Midsoles, Liners, etc. PLASTICS—Special Purpose Molding Compounds and Laminates RUBBER—for Floats, Grommets, Gaskets, Bearing Seals, etc.
FABRICATING—Including Converting, Combining, Coating, Embossing, and Molding DEVELOPMENT—Research and Engineering of Unique Materials, Parts and Products

RMB

Ultra-Light
Miniature Ball Bearings



UL Series
12 sizes from 0.1181" OD — 0.0394" Bore to 0.7480" OD — 0.3937" Bore

PRECISION SPACE SAVERS

Combining small OD's with relatively large bores, RMB Ultra-Light Miniature Ball Bearings offer the designer precision bearings that save on space.

Used in such devices as instrument gear trains, gyroscopes, and synchro motors, bearings in the RMB Ultra-Light series are of Conrad type construction with deep groove, uninterrupted raceways. They are manufactured to boundary dimensions established by Anti-Friction Bearing Manufacturers Association (AFBMA), and all but the two smallest sizes feature a balanced 2-piece ball separator.

RMB Ultra-Light Ball Bearings—the precision bearings that save space—are just part of the complete RMB line of over 250 miniature and instrument bearings available for prompt delivery. For full information, write for our Catalog 50, or see our catalog in Sweet's Files.

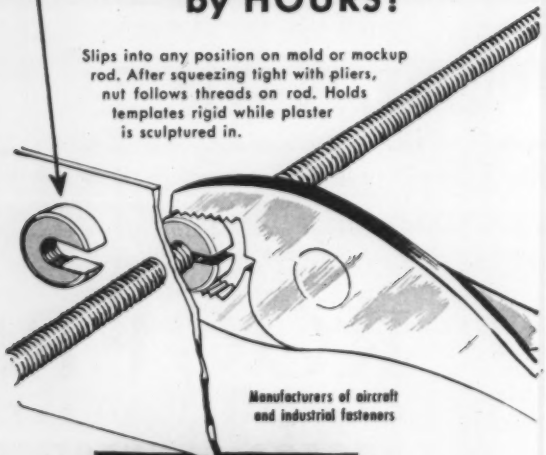
LANDIS & GYR
INCORPORATED
45 West 45th St. New York 36, N.Y.

Circle 572 on page 19

SLIP-SQUEEZE

reduces assembly time by HOURS!

Slips into any position on mold or mockup rod. After squeezing tight with pliers, nut follows threads on rod. Holds templates rigid while plaster is sculptured in.



Manufacturers of aircraft and industrial fasteners

Nutt-Shel

811 Airway
Glendale 1, Calif.
CH 5-3693 Citrus 4-4191

Circle 573 on page 19

New Parts

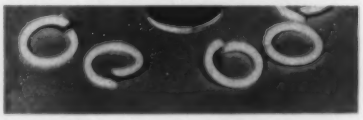
in. Class 2 NC or NF threads are tapped square with the face and counterbored. Nuts are free of burrs and cutoff marks, and require no further processing. **Gries Reproducer Corp.**, 125 Beechwood Ave., New Rochelle, N. Y.

Circle 895 on page 19

Back-Up Rings

for O-rings are solid-split type

Kelon-T solid-split type back-up rings are easily installed in both internal and external applications. They protect and extend endur-



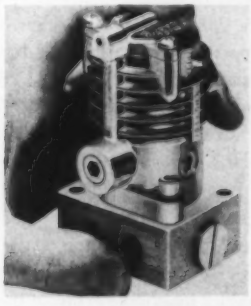
ance, and improve performance of O-rings at high temperatures or in fluids which have adverse effects on O-rings and other back-up materials. The rings have been assigned military standards MS-28774 and MS-9058. **W. S. Shamban & Co.**, 11617 W. Jefferson Blvd., Culver City, Calif.

Circle 896 on page 19

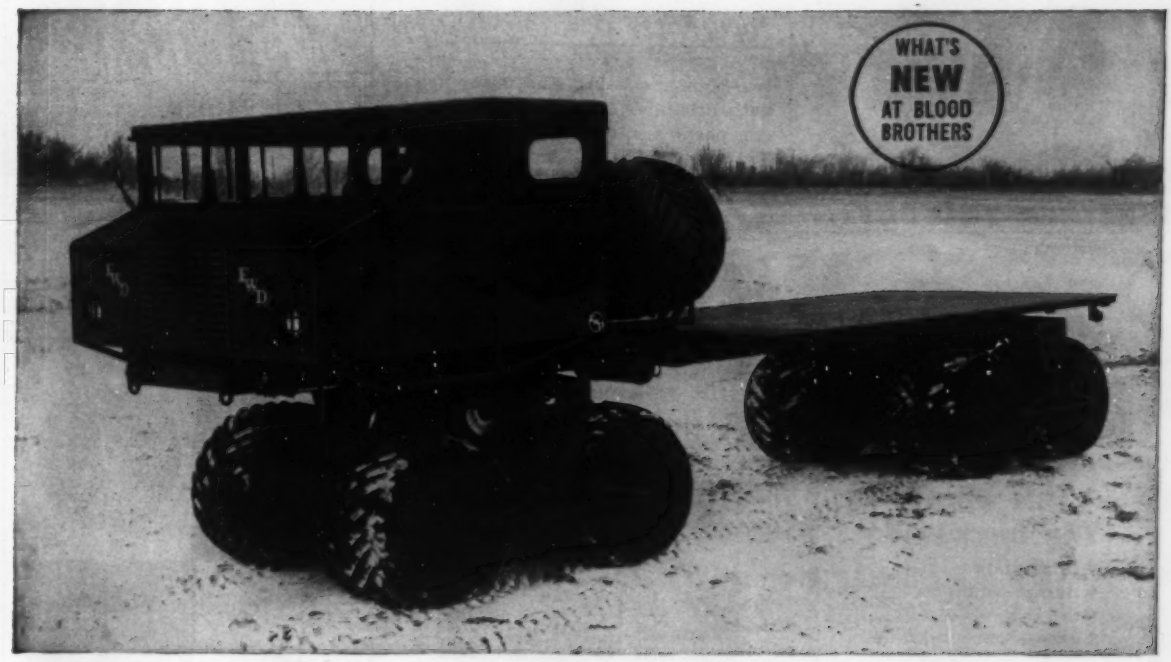
Miniature Valve

for pressures from 15 to 140 psi

Bantam four-way pilot-operated valve of single solenoid design controls small, double-acting cylinders and similar devices. It is 4 in. high and weighs 30 oz. Unit, which has only three working parts, pro-



vides extremely fast response and bubble-tight sealing. Valve body is anodized aluminum and moving parts are stainless steel, with Hycar seals. Valve is designed for



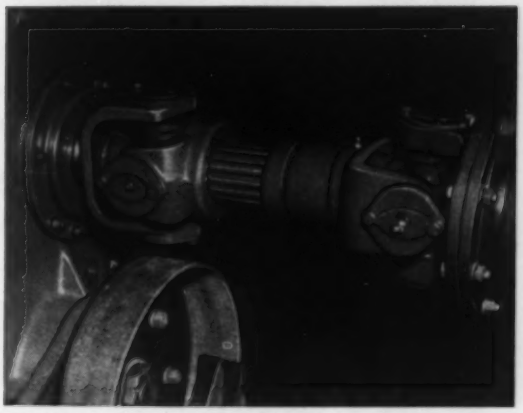
Over swamp, sand and snow, FWD TERACRUZER delivers Fire Power with BLOOD BROTHERS UNIVERSAL JOINTS

Matador guided missiles are transported virtually anywhere by the new Air Force TERACRUZER, designed and built by The Four Wheel Drive Auto Company and equipped with "pillow" tires by Goodyear Tire and Rubber Company.

This revolutionary vehicle required universal joints that could "take it" over the roughest terrain. That's why the builders specified Blood Brothers Universal Joints — known for precision balance, dependability and long life.

You too, will find that on standard or special vehicles — whatever your requirements — Blood Brothers Universal Joints deliver superior performance.

Next time you're up against a universal joint problem, write or call Blood Brothers. Our engineers will gladly cooperate with you.



Selected for this Four Wheel Drive Auto Company project, a dependable Blood Brothers Universal Joint functions off the transmission of the TERACRUZER.

BLOOD BROTHERS MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

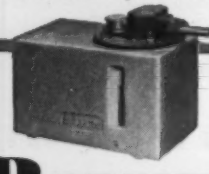
Circle 574 on page 19

WHETHER YOU BUY...

OR SPECIFY...

This Unit Is The Answer To

- *production waste*
- *design problems*
- *fire risk*
- *excessive repair bills*



BIJUR

AUTOMATIC LUBRICATION

Automatic lubrication is one thing that designers, plant engineers and production men insist on these days —for their own machinery . . . and the equipment they manufacture. And careful purchasers make sure the automatic lubrication systems they buy are *Bijur Systems.*

For nothing protects like Bijur. Bijur Systems save production time and repair bills . . . reduce downtime and fire risk . . . lengthen machine life . . . and eliminate product spoilage due to over-lubrication. Bearings are never thirsty for oil, never flooded.

That's why it's just good business to have a custom-engineered Bijur System on the equipment you own, and *design* one into the equipment you manufacture. Installation is easy, cost is minimal, savings are substantial. Write today for *all* the facts about Bijur Systems! 1034

P-3

BIJUR
LUBRICATING CORPORATION
Rochelle Park, New Jersey
Pioneers in Automatic Lubrication

Circle 575 on page 19

New Parts

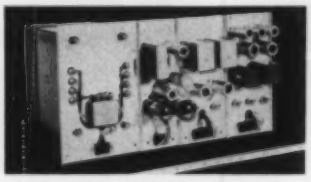
two-point mounting, and is for use with pressures from 15 to 140 psi. All ports are tapped ¼-in. NPT. **Valvair Corp.**, 454 Morgan Ave., Akron 11, O.

Circle 897 on page 19

Control Systems

for machine-tool applications

Automatic size control, gaging, inspection and classifying can be added to machine tools by standard systems made up of combinations of seven standard compo-



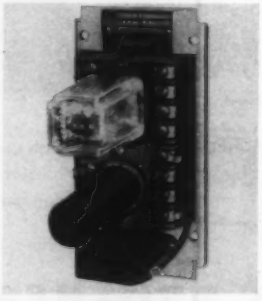
nents. Typical system adapted to use on centerless grinder includes meter-type size indicator, transducer head of comparator type for size control, servo motors, electronic classifier for operating reject gates and shutoff, and power amplifier for servo drive motors. **Cargill Detroit Corp.**, Birmingham, Mich.

Circle 898 on page 19

AC Sensitive Relay

incorporates plug-in transistor amplifier

Relay is designed to resist vibration, corrosion and shock. It incorporates a two-pole, double-throw plug-in relay protected by

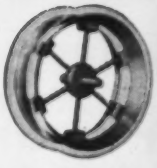


clear polystyrene dustproof cover, long-life plug-in transistor amplifier and power pack module, 12-v dc sensing circuit, and sensing circuit current less than 0.002 amp.

ELECTRIC
Wheels · Axles · Spindles

DIVIDED WHEELS
Generally used as dolly, tail or caster wheels

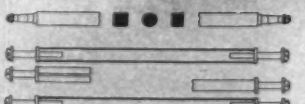
FOR TRUCK TIRES
Full drop center rim to utilize used truck tires on larger implements



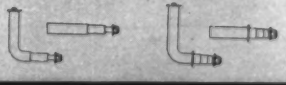
PLANTER WHEELS
Steel rim or for use with planter rubber tires

SIX BOLT SERIES
Light and heavy —widest range of implement use

Four bolt series for light implements



Hub and bearing combinations available. Stub spindles and full length axles.



Our Engineers Invite Your Inquiries

ELECTRIC WHEEL COMPANY
DIVISION OF THE FIRESTONE TIRE & RUBBER COMPANY
2809 SPRUCE · QUINCY, ILLINOIS

Circle 576 on page 19

NEW, LOW-COST RUBBER PROCESS FOR PROTOTYPES

1 *Prototype "boot"* required in development project. Tooling cost by standard methods: $2900; by KOTOKAST: $450.

2 *Bellows* for engineering prototype for dimensional or installational check in a mock-up assembly. Tooling cost by standard methods: $280 *plus* charge for each engineering change. Cost by KOTOKAST: $15 *plus* $8 for each change.

3 *Prototype covering element* impossible to produce in one piece by any other method. Tooling cost by KOTOKAST: $29.

4 *O-ring* that was required in limited quantity. Tooling cost by standard methods: $65; by KOTOKAST: $15.

KOTOKAST *offers you prototypes as low as 1/10 standard cost*

Now, you can obtain time saving and inexpensive prototype parts (rubber or plastic) for product development. The newly developed KOTOKAST process eliminates expensive molds in rubber fabrication. In addition, most parts that would be economically impractical or physically impossible to produce by regular techniques can be readily manufactured by KOTOKAST.

- *Up to 90% savings*—KOTOKAST requires minimum tooling costs.
- *Broad range of sizes and shapes; variety of materials*—KOTOKAST has almost limitless possibilities.
- *Complete laboratory facilities*—KOTOKAST is a development of Minnesota Rubber & Gasket Co. Complete engineering facilities and a full technical staff are at your disposal.

New FREE folder offers details—KOTOKAST production is outlined in a new, illustrated folder. Write for your copy today. Write also if you would like an estimate or specific product information.

KOTOKAST is a Trademark of Minnesota Rubber & Gasket Co.

MINNESOTA RUBBER AND GASKET COMPANY
3630 Wooddale Avenue, Minneapolis 16, Minnesota, Phone WEst 9-6781
Affiliated Operating Divisions: Minnesota Silicone Rubber Co. • Minnesota Rainbow Rubber Co. Minnesota Latex Rubber Co. • A-P-D Co.—Research Div.
Department 814

KOTOKAST

Specifications for WARREN'S *NEW* Flange Mounted Rotex Pump

FLANGE MOUNTED OIL PUMP

RANGE

1. From 5 to 750 g.p.m. dependent upon speed.
2. Discharge pressure to 300 p.s.i.g. dependent upon pump size.

MATERIALS

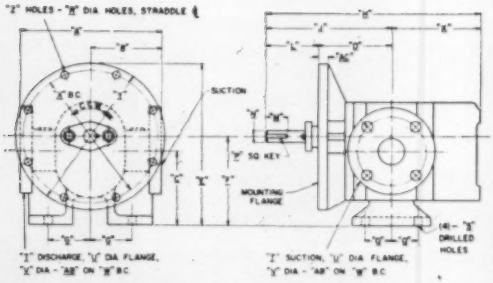
Standard construction All Iron. Ductile Iron or Steel available for applications involving thermal or physical shock.

FEATURES

1. High volumetric efficiency permits wide range of speeds.
2. Timing Gears allow high speed operation at low pitch line velocities eliminating danger of cavitation.
3. Self-priming possible because of close internal clearances.
4. Available with either Mechanical Seal or Conventional Stuffing Box.

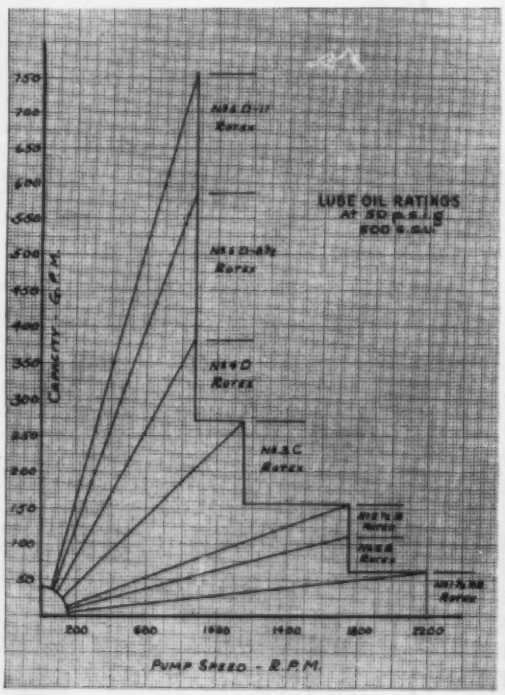
APPLICATIONS

Diesel Engines
Gasoline Engines
Reduction Gears
Turbines
Hydraulic Systems
Machine Tools



G-H ROTEX PUMP NO.	REFERENCE LETTER A	B	C	D	E	F	G	H	J	K	L	M	N
1½ AB	8	4	4¼	4⅜	8 13/16	5¼	2⅜	12½	7⅝	4 3/16	3 1/16	1¼	6875 6870
2B	11	5½	3 9/16	5⅜	9⅜	4⅜	3 11/16	14⅜	8½	5 5/16	3⅜	1½	9375 9370
2½B	11	5½	3 9/16	6⅜	9⅜	4⅜	3 11/16	15⅛	9½	6⅜	3⅜	1½	9375 9370
3C	13	6½	5 1/16	7⅜	14⅜	6⅜	4½	21⅜	13⅜	8⅜	5½	1¾	12500 12495
4D	16⅜	8 1/16	6⅜	8½	16½	9	6 1/16	23½	13⅜	9½	5¼	2¼	14375 14370
6D-8½	16⅜	8 1/16	5 11/16	10	18½	9	6⅜	26½	15¼	11	5¼	2	14375 14370
6D-11	16⅜	8 1/16	5 11/16	11½	18½	9	6½	29 15/16	16 7/16	12½	5 3/16	2¾	14375 14370

G-H ROTEX PUMP NO.	REFERENCE LETTER P	Q	R	S	T	U	V	W	X	Y	Z	AB	AC
1½ AB	3/16	1½	3/8	7/16	1½	3	3/8	3½	6	7½	4	(4) HOLES	3/8
2B	1/4	2⅜	3/8	9/16	2	6	7/16-11	4½	8½	10	4	(4) STUDS	1/2
2½B	1/4	2⅜	3/8	9/16	2½	7	7/16-11	5½	8½	10	4	(4) STUDS	1/2
3C	1/4	3½	3/8	3/4	3	7½	7/16-11	6	13	15	8	(4) STUDS	1/2
4D	3/8	4¾	3/8	13/16	4	9	7/16-11	7½	13	15	8	(8) STUDS	5/8
6D-8½	3/8	6¼	3/8	13/16	6	11	7/16-10	9½	13	15	8	(8) STUDS	5/8
6D-11	3/8	7½	3/8	13/16	6	11	7/16-10	9½	13	15	8	(8) STUDS	5/8



WARREN PUMPS, INC.
WARREN MASS.

G-5

New Parts

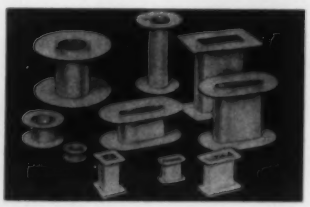
Terminal board is provided for making external connections. High-speed operation permits use of relay in stop motion or sorting circuits. Long-distance remote control, liquid-level control and photocell use are other applications. Rated to 10 amp, 110 v, 60 cycles, relay is available in open-type panel or NEMA Type 1 general-purpose enclosure. **Cutler-Hammer Inc.**, 328 N. 12th St., Milwaukee, Wis.

Circle 899 on page 19

Nylon Coil Bobbins

of one-piece construction

Nylon coil bobbins are available in a variety of sizes in round, square, rectangular and oval shapes. One-piece construction offers ease of winding and handling, greater accuracy, uniformity and rigidity, and



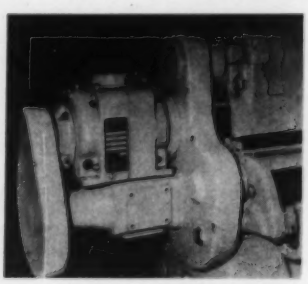
higher dielectric strength. Bobbins are used primarily in the electronic and electrical industries for transformers, solenoids, tuning coils, and in deflection, audio, reactor, relay, filter, delay and video circuits. **Gries Reproducer Corp.**, 400 Beechwood Ave., New Rochelle, N. Y.

Circle 900 on page 19

Traverse Drive

for winding machinery

Variable-speed transmission, available for traverse applications on winding machinery, provides infinite speed range with high accuracy of speed holding and speed



Circle 578 on page 19

Circle 579 on page 19→

NOTHING *can equal Stainless Steel*

in its unique combination of properties

No other design material can match Stainless Steel in its combination of desirable properties: corrosion resistance, strength, hardness, beauty, cleanability and easy fabrication. For a reliable source of supply, United States Steel offers you the widest range of types, finishes and sizes.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS STAINLESS STEEL

SHEETS • STRIP • PLATES • BARS • BILLETS
PIPE • TUBES • WIRE • SPECIAL SECTIONS

USS

UNITED STATES STEEL

FOR HIGH TEMPERATURE STRENGTH. The Ryan Firebee is a pilotless jet airplane that flys about 600 mph at altitudes up to 40,000 feet. All three armed services are using it for target practice—to simulate attacking aircraft. Fuselage and turbojet engines use substantial quantities of Stainless Steel—mostly because of its excellent strength/density ratio at elevated temperatures.

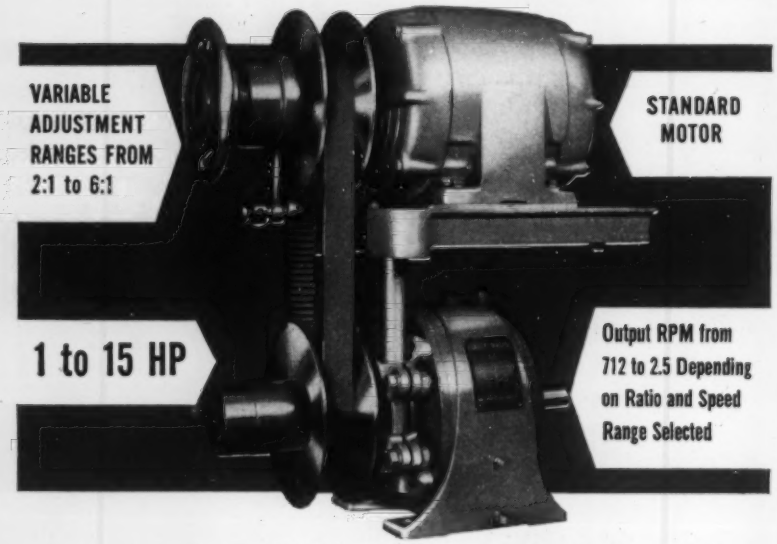
FOR CORROSION RESISTANCE. If you're a photographer, you know that hypo is awfully corrosive. This print washer (it holds 75 8x10 prints in one loading) is made completely from Stainless Steel by the Arkay Corporation, in Milwaukee. For proof that Stainless is easy to fabricate, notice that the drum has 1,700 perforations, and double lockseam soldered joints are used throughout.

FOR TAKING A BEATING. These supermarket check-out counters are made from USS Stainless Steel. They withstand the pounding of heavy containers and are unaffected by corrosive meat and produce juices. It only takes 20 minutes for one girl to clean all eleven counters shown here. The Robert Becht Company of Cincinnati made them.

NEW FROM FOOTE BROS.

Vari-Mount

VARIABLE SPEED MOTORIZED DRIVE


VARIABLE ADJUSTMENT RANGES FROM 2:1 to 6:1
STANDARD MOTOR
1 to 15 HP
Output RPM from 712 to 2.5 Depending on Ratio and Speed Range Selected

VARI-MOUNT—the new Variable Speed Motorized Drive offers infinitely variable speed selection, greater flexibility of operation, wide adaptability, easier maintenance and the sound design you expect from Foote Bros.

With a Vari-Mount, you can use your own motor—old or new NEMA Standard—or, the unit can be supplied with any standard motor of your choice. The Vari-Mount Reducer incorporates Duti-Rated Lifetime Gearing with file-hard tooth surfaces and tough, ductile cores for maximum life and efficiency.

Positive handwheel control of the adjustable pulley permits pin-point accuracy in speed selection over the entire range. Vari-Mount Units may be equipped with Remote or Automatic speed selection devices if required.

Spring loaded, self-centering Variable Pulley and close-coupled in line design insures permanent belt alignment, smoother performance, and minimum overhung load on motor bearing. No thrust load is imposed on motor bearings at any speed or during speed changes.

Quick belt changes made possible by the wide-open design of the Vari-Mount, together with easily accessible lubrication fittings make maintenance an easy matter.

3 TYPES 7 standard mounting positions

Want complete details?...Write for Vari-Mount Catalog today

this trademark stands for the finest industrial gearing made

T. M. REG. U. S. PAT. OFF.

FOOTE BROS. Duti-Rated LIFETIME GEARING

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION

4567 SOUTH WESTERN BOULEVARD • CHICAGO 9, ILLINOIS

Circle 580 on page 19

New Parts

reset. It maintains preset speed ratio between output and input shaft. Drive provides expanded speed scale at minimum speeds for work with fine wires. Special controls can be used to change traverse rates according to predetermined schedule to produce potentiometers or coils of special characteristics. Drive is compact, lightweight, and is available with a variety of built-in reducers of spur and wormgear types. **Graham Transmissions Inc.**, Menomonee Falls, Wis.

Circle 901 on page 19

Fluid Control Valve

for pressures from 200 to 5000 psi

Fluid control valve for air, oil or water is available in sizes from ⅛ through ¾-in. for pressures from 200 to 5000 psi. It combines a

floating retro-ball check valve and a tapered, fine-thread needle valve in one compact unit. Body is brass and aluminum for 2000-psi pressures and steel and stainless steel for 5000 psi. **Modrich Fluid Controls Inc.**, 458 Virginia St., Crystal Lake, Ill.

Circle 902 on page 19

Time Acceleration Switch

for missile and rocket applications

Rugged, compact acceleration-time integrating switch for missile and rocket applications is completely

self-contained and actuates when sustained acceleration in excess of internal bias is applied. Hermetically sealed, it conforms to Air

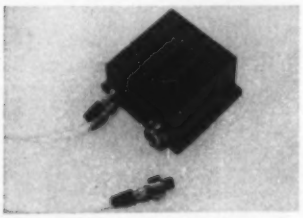
Force environmental specifications and can be adapted to a range of acceleration and time parameters. Contact closure occurs when missile or rocket reaches a velocity of approximately 460 ft per second under conditions of sustained accelerations between 4 and 15 *g*. **Magnavox Co.,** Special Devices Dept., 2131 Bueter Rd., Ft. Wayne, Ind.

Circle 903 on page 19

Accelerometer Systems

for continuous operation up to 450 F

Glennite AD series high-temperature accelerometer systems offer versatility in shock and vibration testing. They operate under severe environmental conditions encountered in missile and high-speed aircraft applications. Units are designed for continuous operation at temperatures to 450 F with no temperature compensation and no external cooling required. Each amplifier and cathode follower is individually potted with plastic compound to insure performance



under extreme conditions. Filament in amplifier can be set for operation at either 6.3 or 26 v. Four systems are available, with two having a wider acceleration range and higher frequency response. **Gulton Industries Inc.,** 212 Durham Ave., Metuchen, N.J.

Circle 904 on page 19

Rivet-Type Fastener

for blind application has high strength

Tau Bolt fastener is a rivet-type unit of hardened alloy steel for blind application. Having a diameter of ¼-in., it is available in a variety of grip lengths with either countersunk or brazier head. Features include positive mechanical lock, high shear strength and high tensile preload. Fastener is of four-

Circle 581 on Page 19→

*Specify HAMILTON QUALITY CASTINGS®

Call on the skill of experts when your production line faces the need for difficult-to-make parts. Specify HAMILTON QUALITY CASTINGS®

Hamilton Foundry has "cracked the hard nuts" for 66 years . . . is thoroughly experienced at producing castings to meet regular and special applications. Seasoned engineering, and quality control throughout assure you of sound castings with dimensional accuracy.

And remember this important advantage: HAMILTON QUALITY CASTINGS® are produced in a wide variety of irons to meet the most exacting properties required by your service conditions.

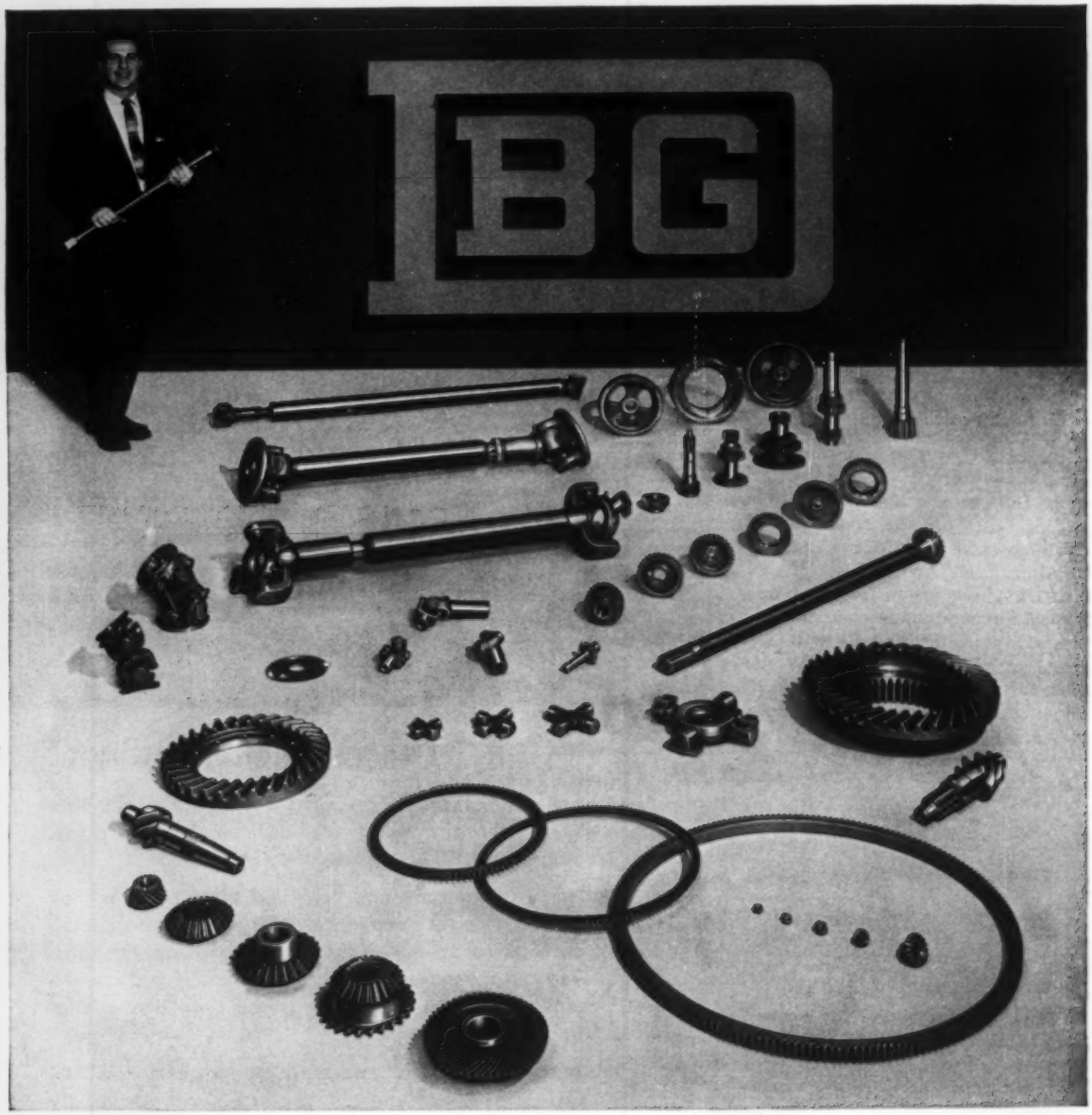
Call on Hamilton Foundry for HAMILTON QUALITY CASTINGS®

HAMILTON QUALITY CASTINGS®

GRAY IRON
ALLOYED IRON
MEEHANITE®
NI-RESIST®
DUCTILE NI-RESIST
NI-HARD
NODULITE®

H57-3

THE HAMILTON FOUNDRY
AND MACHINE CO.
1551 Lincoln Avenue • Hamilton, Ohio
Phone TWinbrook 5-7491



The Principle That Builds Better Gears, Joints and Axles

When DBG built their first automotive gear back in 1912, a principle was born: "Build an outstanding product at a competitive cost . . . but never sacrifice quality for price."

Word spread. DBG grew. People who asked us to design or build one product asked us to design and build other types. Result: now, you'll find DBG products in fields as diverse as aviation, automotive, instrument, road building and heavy construction equipment. DBG quality is found in power take-off universal joints and heavy duty drivelines . . . instrument gears and gears for giant off-the-road equipment. The result is a wide range of drivelines, bevels, gears and axles, and *only* a *few* are shown above!

Why not capitalize on this experience? Write or phone *today*.

Drivelines
Bevels
Gears

57A

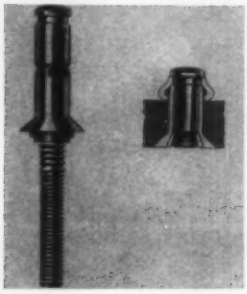
DETROIT BEVEL GEAR COMPANY

Producers of QUALITY GEARS, AXLES, UNIVERSAL JOINTS

A subsidiary of the Gear Grinding Machine Company, Detroit, Michigan • **8128 Jos. Campau Avenue, Detroit 11, Michigan, TR 2-0200**

Circle 582 on page 19

piece design, consisting of pin, expansion sleeve, filler sleeve and locking collar. Solid steel collar



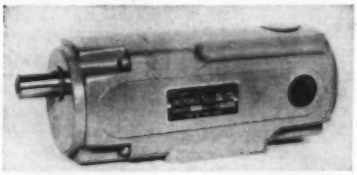
locks pin permanently in position. **Huck Mfg. Co.**, 2480 Bellevue Ave., Detroit 7, Mich.

Circle 905 on page 19

Universal Motor

with four-position output shaft

Series 1200 universal motor is furnished for direct connection with output speed of 1125 to 27,000 rpm and with horsepower from 1/10 to 1/3, intermittent or constant-duty cycle. Double-reduction geared units are available to provide ratios to 24:1 with output shaft in any of four-quadrant positions. Frame



is either totally enclosed, nonventilated, or open, fan-ventilated. Voltages are 6 to 230, dc, and to 230, ac. **Portable Electric Tools Inc.**, 320 W. 83rd St., Chicago 20, Ill.

Circle 906 on page 19

AC Contactors

control ac motors, solenoids and heaters

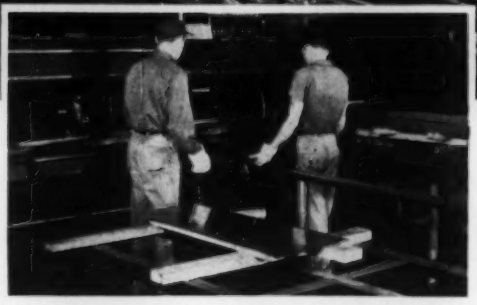
New three and four-pole ac contactors are single-unit versions of a mechanically-interlocked reversing contactor. Well suited for built-in control, they find wide use in the control of ac motors, solenoids, heaters and other loads. Single-throw, double-break contacts

(*Continued on Page* 290)

ACCURATE,
CONTROLLED,
Timed
LUBRICATION
The New 82-V vacuum pumping unit "with dry sight feed," an exclusive Manzel development will end your liquid sight feed problems. Install them on any existing Manzel lubricator. Now — more accurate than ever . . . it will pay you to get complete detailed information on this dependable, field-proven Manzel unit.
WRITE FOR COMPLETE CATALOG
Manzel
LUBRICATORS • CHEMICAL FEEDERS • SLURRY PUMPS
276 BABCOCK STREET • BUFFALO 10, NEW YORK
A Division of Houdaille Industries, Inc.

Circle 583 on page 19

1 PUNCHING— Presses used for punching holes, knockouts, and for stamping small parts are strategically located for efficiency. Some of them run at the rate of 108 strokes a minute, with capacities up to 250 tons. Equipment like this means high-speed production of big-volume runs at low unit cost.



2 SHEARING— Berger shears operate at speeds from 40 to 60 strokes a minute. They can cut sheet steel up to 14' on the shortest dimension . . . handle medium-hard stock up to ⅜" thick. Berger designers and craftsmen know how to use this equipment to give you the most for your money.

PLANNING OR FABRICATING A SHEET STEEL PRODUCT?

...Republic can take the

You may not realize how many different products are made in Republic's Berger Division plants because many are fabricated for other manufacturers and marketed under their brand names. We will manufacture *your* product in volume runs—engineer, fabricate, finish, pack and ship, all to *your* specifications.

Some of our contract-fabricated products are completely assembled units with operating mechanisms installed. Others are sheet metal assemblies that leave our plants finished with a prime coat, ready for final finishing, assembly and packing by our customer.

Our large stock of standard tools and dies and the specialized equipment of our Berger Plants are available to you. Often we can reduce costly tooling investments because we already have the tools to do the job. Because you use our facilities, you can eliminate the overhead problems of building or expanding your plant.

Constant research and development at Berger have resulted in advanced processes and equipment to make your fabricated sheet steel products more attractive, and more economical. Furthermore, our facilities and fabricating experience provide you with the same high quality you see in our own products—lockers, office furniture, shelving and steel kitchens.

If you have a sketch or blueprint, send it along to us with complete specifications. We'll tell you promptly what Berger's specialized service can do for you. Learn more details in Bulletins 793 and 908.

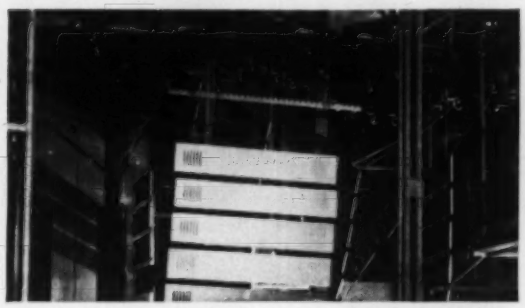
REPUBLIC

REPUBLIC STEEL

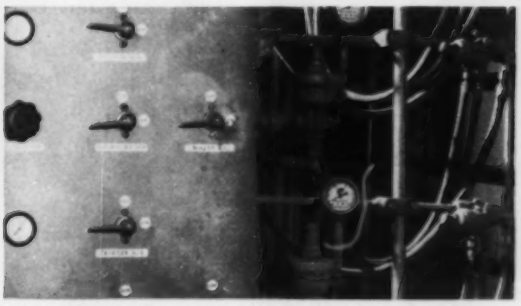
World's Widest Range of Standard Steels

3 FORMING—Brakes run at speeds as high as a stroke a second, and range in capacity from 60 to 500 tons. This means that Berger can handle a variety of production, and various gages, simultaneously. Your product keeps moving.

4 WELDING—Berger's major plant facilities include the very latest welding equipment and techniques. Eighty-eight welders are strategically located to do the best job . . . and do it most economically. When Berger takes your contract, your products keep rolling.

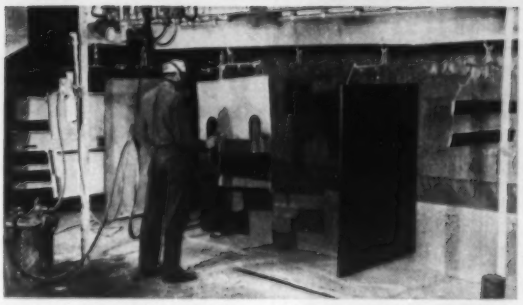


5 BONDERIZING—We're proud of our finishing facilities. And, our new Bonderizing equipment makes them better than ever. As it passes along our Bonderizing line, your product is given exceptional ability to take and hold a fine painted finish—and it acquires superior rust-resistance.



6 ELECTROSTATIC SAFEGUARD—Another reason why Berger-applied finishes are unexcelled. Not one speck of dust can penetrate this electrostatic screen to settle on your product. Electrostatic recovery of atomized paint means greater economy, too.

whole job off your hands



7 PAINTING—We're equipped to paint over 87,000 square feet of steel surface each hour! Equipment includes degreasers for cleaning mill stock parts, mechanical Bonderizers, electrostatic safeguards, 32 spray booths and six dip tanks. Plus 40 baking ovens to assure beautiful, lasting, baked-on finishes that match your sample for color.

8 PACKING AND SHIPPING—The product above is being shipped knocked-down, in cartons. More Berger packing equipment includes newest machines for crate-making and automatic nailing. Beyond our doors, more advantages—you are shipping from centrally-located Canton, Ohio. From planning to packaging, Berger can take the whole job off your hands.

STEEL

and Steel Products

REPUBLIC STEEL • BERGER DIVISION
Dept. C-4002
1044 Belden Avenue, Canton 5, Ohio

Please send Bulletins 793 and 908 describing Berger fabricating facilities and abilities.

Name _____ Title _____

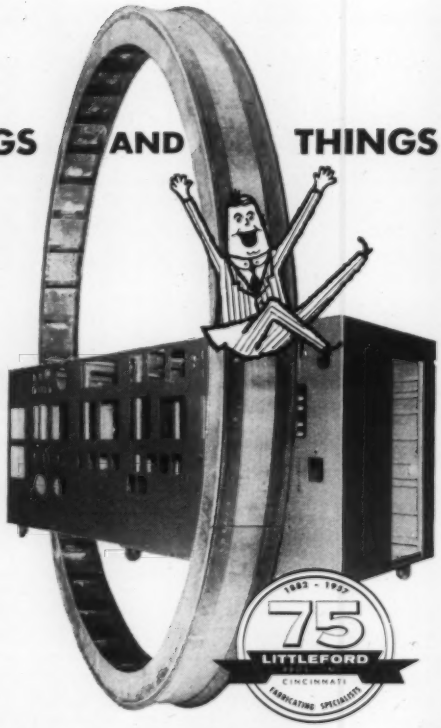
Firm _____

Address _____

City _____ Zone ____ State _____

Circle 584 on page 19

CABINETS, RINGS AND THINGS



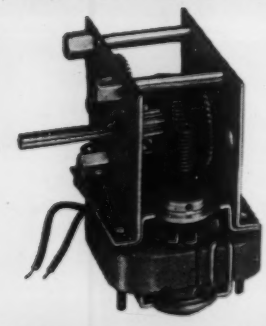
Your design faithfully reproduced--blueprint to you PDQ. Control cabinets, rings, chemical tanks, storage bins, air ducts, whatever–fabricated any shape, almost any size, any metal. No quibble, no compromise.

Where? In Littleford's modern 175,000 sq. ft. fabricating plant...by Littleford's 300 skilled metalworking craftsmen...backed by 75 years experience.

Expensive? No. Send blueprints for revealing estimates. Littleford Bros. Inc., dept LB 270, 424 E. Pearl St., Cincinnati 2, Ohio.

LITTLEFORD fabricating specialists since 1882

Circle 585 on page 19



important **quiet**
important **quality**
in **low cost**
SLOW MOTION
BREVEL
new worm motor

BREVEL

Engineered for smooth, quiet, continuous duty at low cost, Brevel's Series W motors have multi-blade internal cooling fans built in on both sides of rotors . . . can be operated in any position. Single or dual shafts, variable shaft lengths, speed and rotation are available to suit application. Skilled designing, production techniques and rigid pre-testing assure quality, long motor life and trouble-free operation. Write, wire, phone TODAY for Bulletin M-420 and for bulletins on other standard or special low-cost Brevel motors.

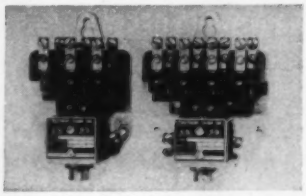
BREVEL PRODUCTS CORP., 601 West 26th St., New York 1, WAtkins 4-4737

SLOW MOTION IS OUR BUSINESS!

New Parts

(*Continued from Page* 287)

are individually sprung to maintain contact alignment. Contacts are fine silver in melamine arc chutes. Contacts are rated at 5 amp ac voltages to 600 v. Horse-



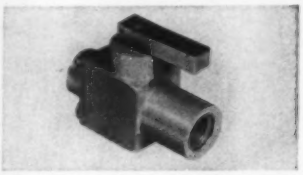
power ranges from 3 hp for 440/550-v service to 1 hp for 115-v single-phase service. **Struthers-Dunn Inc.**, Lambs Rd., Pitman, N. J.

Circle 907 on page 19

Ball Valves

for pressures to 3000 psi

Manually operated straight-through ball valves provide leakfree flow control of hydraulic fluids, fuels, oxidizers, water, oils and air at pressures to 3000 psi. Design includes self-wiping and self-lapping action. Ball and seat are not af-



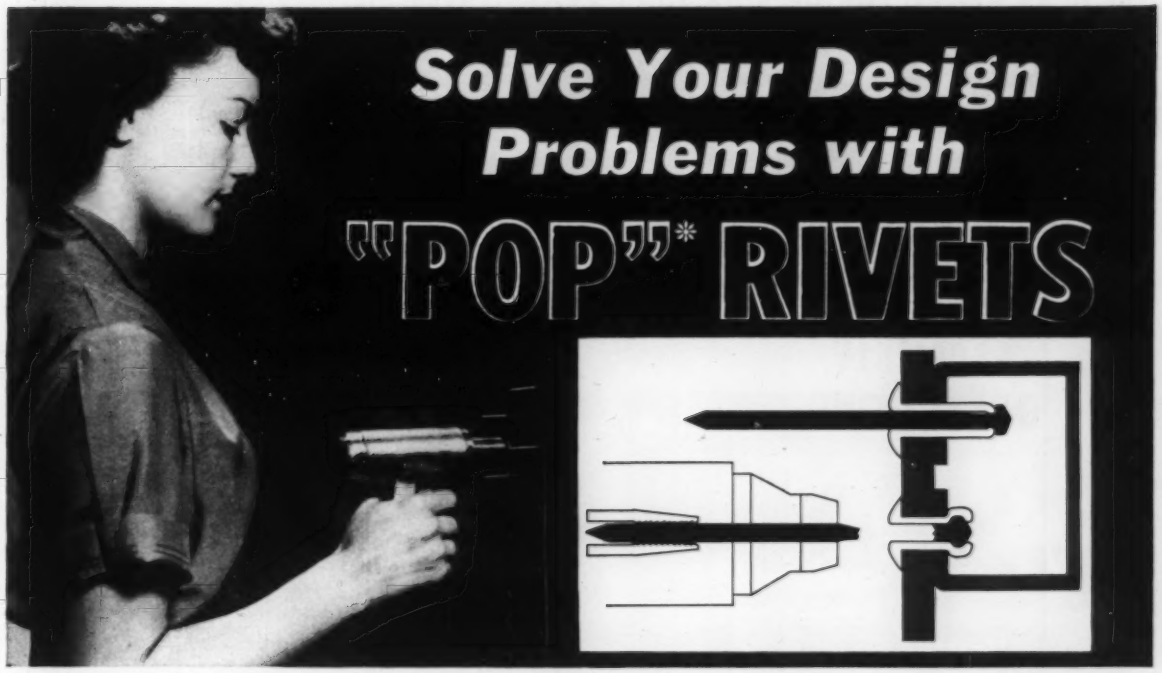
fected by vibration, shock or acceleration. Operating temperatures from − 320 to 650 F are withstood by the unit. Sizes are available for lines from ¼ to 4 in. **Hydromatics Inc.**, Cedar Grove, N. J.

Circle 908 on page 19

Cylinders

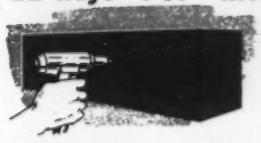
are double or single-acting

Allenair Type B cylinders are for air, water or hydraulic service. They are available in five bores from 1½ to 4 in. with single or double-ended rods. Cylinders have corrosion-resistant brass or steel barrels, stainless steel rods and Nylined bearings. Interchangeable foot, flange and swivel mounts



Solve Your Design Problems with "POP"* RIVETS

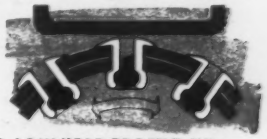
12 ways "POP" Rivets save money, increase design flexibility, and do a superior job.



1. LOWER INSTALLED COST. "POP" Rivets can probably save you money even if your present fasteners are FREE.

2. SIMPLE TO USE. Installed by one operator from one side "POP" Rivets are so easy to use that a worker can set up to 1200 hourly.

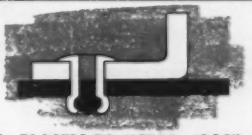
3. HIGH GRIP STRENGTH. Exert as high as 600 pounds gripping pressure between parts.



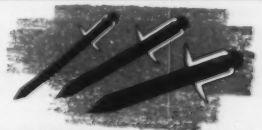
4. LOW HEAD PROFILE. Where space is important, "POP" Rivets' minimum head height is the answer.

5. NON CRITICAL HOLE DIAMETER. Designer wants holes small, production wants holes larger. "POP" Rivets make both happy.

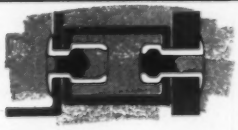
6. VIBRATION PROOF. "POP" Rivets cannot back out or become loose. No lock washers or nuts required.



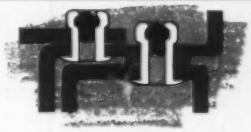
7. PLASTIC TO METAL. "POP" Rivets do not fracture the plastic because it is held in compression.



8. VARIETY OF MATERIALS. Made in aluminum, steel and Monel, in wide range of sizes.



9. THROUGH THICK AND THIN. "POP" Rivets hold tight in thin materials. No threads to strip. Fasten thin sheets or thick and thin with equal ease.



10. GREATER DESIGN FLEXIBILITY. Product design can be made more economical often eliminating separate pieces.

11. CUTS HANDLING COSTS. Bring the rivet to the work — not the work to the fastener.

12. ASSEMBLY LINE FASTENING. "POP" Rivets can be installed at any point. Lightweight, high production tools set rivet. No need for heavy equipment.

See how "POP" Rivets save time and money, help you solve design problems at our Do-It-Yourself demonstration unit at booth No. 1839.

1957 Design Engineering Show
New York Coliseum
May 20 to 23

*Trade Mark

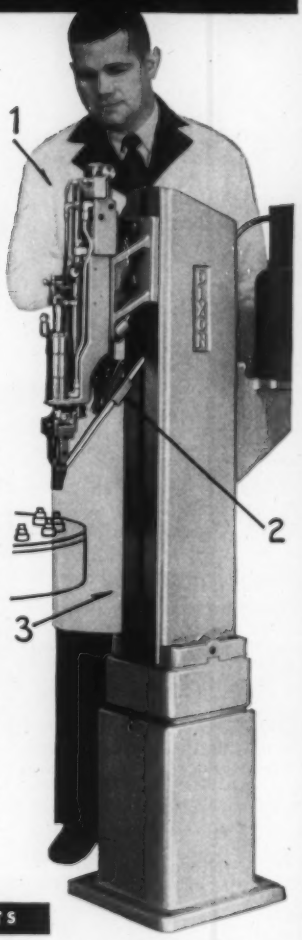
"POP" RIVET DIVISION
UNITED SHOE MACHINERY CORPORATION
West Medway, Massachusetts • KEystone 3-6611

Circle 587 on page 19

SEE IT AT DESIGN ENGINEERING SHOW • BOOTH 1826

Announcing New Standard DIXON "Auto-Positioner"

SIMPLIFIES SMALL PARTS ASSEMBLY OPERATIONS



AUTOMATICALLY GUIDES PARTS OF 1/16" TO 3" O.D. SIZE AT RATES UP TO 7200 PER HOUR

The new Dixon "Auto-Positioner" combines three standardized units — (1) Escapement, (2) Automatic Positioner, and (3) Mounting Structure — and now provides an economical solution for automating small parts assembly operations. "Auto-Positioners" are easily arranged at single or multiple stations with fixtures, feeders, feed tracks, transfer or indexing tables. The positioner, properly tooled with a proven feeder, can place parts at rates up to 7200 pieces per hour. Full electrical controls are included with provisions for automatic interlocking.

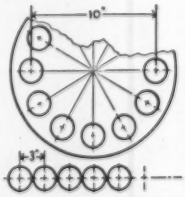
FEATURES OF STANDARDIZED UNITS

1-DIXON PARTS POSITIONER—a compact, self-contained air-operated automatic cycling unit with exclusive built-in sensing features. Automatically stops your machines when parts are missing or malformed. Handles parts of 1/16" up to 3" O.D. size. Engineered for mounting individual chuck jaws to suit varied requirements. Four standard models available with 1", 2", 3", 4" strokes.

2-DIXON PARTS ESCAPEMENT—Automatically releases single parts or in multiples at speeds up to 200 piece-parts per minute. Blank rear finger is easily shaped to suit piece-part. Standard models available for air, solenoid, or mechanical operation.

3-DIXON MACHINE STRUCTURE—Includes rugged semi-steel column with machined T-slots, sturdy base, and spacer blocks to suit varied locating and operating requirements. Compactly designed to fit in small space. Special support brackets available for feeders, work tables, etc.

INDIVIDUAL UNITS OR ANY COMBINATION OF STANDARD COMPONENTS AVAILABLE FROM STOCK. TOOLED "AUTO-POSITIONERS" PROVIDED TO SUIT NEEDS.



May be located at adjacent stations, only 3" apart for straight-line indexing, or on 12-station dial with a 5" fixture radius.

DIXON

WRITE FOR FREE DATA SHEETS
New bulletins supply specifications and application data on standardized units now available from stock.

DIXON AUTOMATIC TOOL, INC.
2310 - 23RD AVENUE ● ROCKFORD, ILLINOIS
AUTOMATIC PARTS HANDLING AND ASSEMBLY EQUIPMENT

New Parts

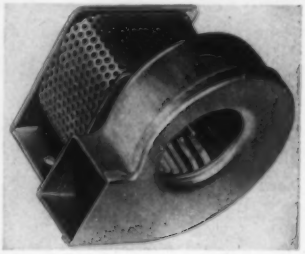
permit mounting in any manner or position. All sizes are available as double-acting or single-acting spring-return types. **A. K. Allen Co.**, 57 Meserole Ave., Brooklyn 22, N. Y.

Circle 909 on page 19

Blower

is compact, 17-cfm unit

Blower is suited for electronic equipment, photographic equipment or other applications. It moves air at 17 cfm, operates at 3000 rpm



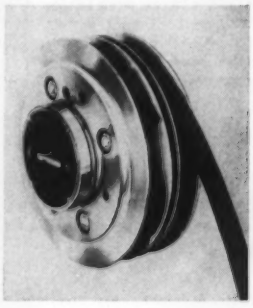
(free air) from a 115-v 60-cycle source. Overall dimensions are 3½ in. wide, 2⅞ in. deep, and 3¾ in. high. **Minarik Electric Co.**, 224 E. Third St., Los Angeles 13, Calif.

Circle 910 on page 19

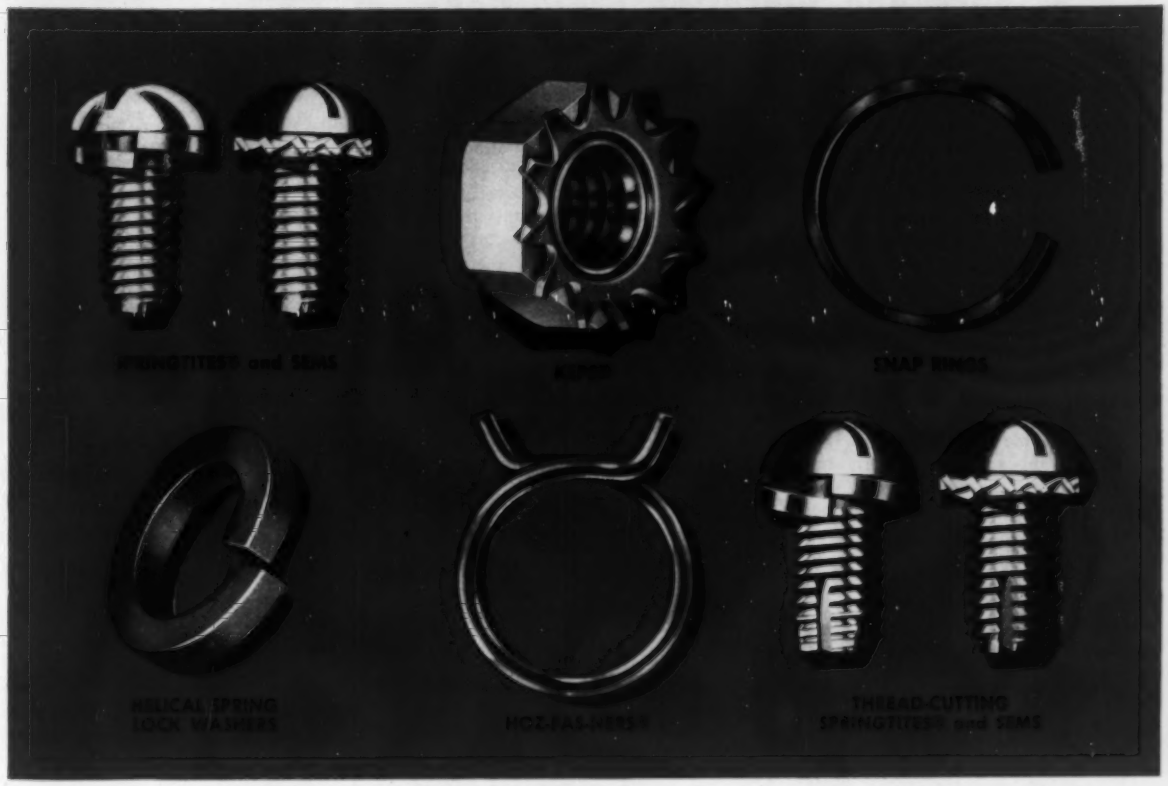
Adjustable-Speed Drives

permit stepless adjustments to 26 per cent

Two-groove C-section drives are for use in the 15 to 20 hp range at motor speeds of 1160 and 1750 rpm. They permit stepless speed adjustments up to 26 per cent. Three new groove sheave pitch di-



WANT TO SPEED PRODUCTION ? ? ?



USE EATON-RELIANCE COST REDUCING INDUSTRIAL FASTENERS

Eaton-Reliance Industrial Fasteners are designed on the basis of time-tested principles . . . but in line with the modern concept of helping industry speed production, cut costs and improve quality.

SPRINGTITES and SEMS—preassembled screws and washers eliminate expensive hand operations.

KEPS—preassembled nuts and serrated washers.

SNAP RINGS—take the place of shoulders machined on shafts and in counterbores—save man hours and material.

HELICAL SPRING LOCK WASHERS—keep tension on assemblies despite thread wear, bolt stretch or expansion and contraction.

HOZ-FAS-NERS—quickly applied to make firm connections on rubber, plastic or fabric hose.

THREAD-CUTTING SPRINGTITES and SEMS—seat firmly, reduce chance of mismating or stripping.

For more than forty-five years the Reliance Division of Eaton Manufacturing Company has been designing and producing quality fasteners for industry. You are invited to use this experience to help solve your own problems. Detailed information is included in your free copy of Engineering Bulletin 4K/3. Just send for it, or ask for a visit from one of our fastening engineers.

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MANUFACTURING COMPANY

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SALES OFFICES: New York • Cleveland • Detroit • Chicago • St. Louis • San Francisco • Montreal

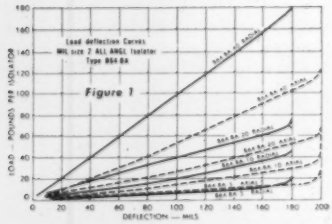
PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

How to Meet Tougher Specifications for Shock and Vibration Protection in Jets and Missiles

You've got to design to tougher specifications for combined shock and vibration isolation if you're going to protect the reliability of electronic controls in today's high-performance jets and missiles. Faster accelerations, zero-length launching, and extreme maneuverability combine to impose shock and vibration loads far beyond current MIL specs. *These severe operating conditions must be reduced to a predictable environment suitable for electronic equipment.*

Isolator Requirements

Higher shock inputs require more stiffness in the isolator, to store more energy for a given deflection, so there will be less energy to dissipate if the isolator bottoms. *Higher vibration amplitudes* call for greater clearances and minimum transmissibility at resonance. And vibration protection *under high-g sustained acceleration* demands a combination of these characteristics.



Use of Performance Curves

The characteristics of an isolator having the stiffness necessary for handling the shock and sustained accelerations of jet and missile take-offs is shown by the curves of Figure 1. These curves can be used in choosing the proper isolator for operation under the expected service conditions, since they show both the deflection of isolators under a wide range of loadings and the maximum allowable deflection due to the combination of static load, sustained acceleration, and vibration amplitude.

A transmissibility at resonance well below three — considered exceptionally low — is shown by the curves of Figure 2. The measurements for these curves were made with a 27-pound load supported on four 10-pound isolators, with double-amplitude vibration input of 80 mils. These curves, showing performance for both base and bulkhead mounting, also indicate that the isolator satisfies the need for *consistent operation in every attitude* of flight, launching, and maneuvering.

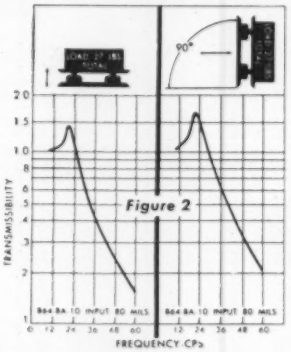


Figure 3 illustrates the construction of the B64 isolator that provides the performance characteristics shown by the curves, yet is dimensionally interchangeable with MIL-size mounts of comparable load ratings.

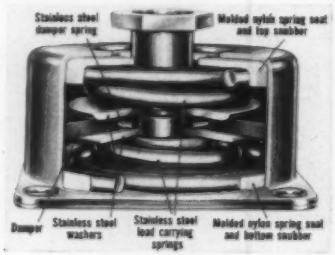

Stainless steel damper spring
Molded nylon spring seat and top snubber
Damper
Stainless steel washers
Stainless steel load carrying springs
Molded nylon spring seat and bottom snubber

Figure 3

Additional Design Data

Other curves of isolator characteristics, and data on their use in designing *for predictable environment in jets and missiles*, are contained in Barry Bulletin 57-2. This bulletin fully describes the complete line of ALL-ANGL Barrymount isolators in standard MIL sizes. Write today for your free copy.

BARRY CONTROLS INCORPORATED

BARRY B MOUNT

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

722 PLEASANT STREET, WATERTOWN 72, MASSACHUSETTS

Circle 590 on page 19

New Parts

ameters are 8.5 to 10.7, 9.5 to 11.7, and 10.5 to 12.7 in. A split tapered bushing is available for the three diameters. **American Pulley Co.**, 4200 Wissahickon Ave., Philadelphia 29, Pa.

Circle 911 on page 19

Electrical Connectors

resist pressure, vibration and shock

Star Line compact, lightweight electrical connectors for military and industrial applications meet and exceed performance requirements of Class A, B, C and E of military specifications MIL-C5015B, as well as NEMA requirements

for power, lighting, control and coaxial circuits. Plugs and receptacles resist water, moisture, oil, gas, dust, pressure, vibration and shock. **Pyle-National Co.**, 1334 N. Kostner Ave., Chicago 51, Ill.

Circle 912 on page 19

Hydraulic Pump

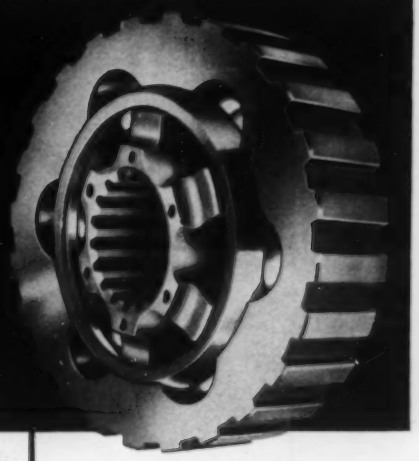
provides 5000-psi system for aircraft use

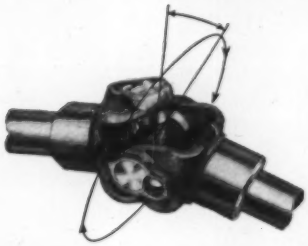
Redesigned 66W Stratopower hydraulic pump provides 5000-psi service in aircraft hydraulic systems with practically no weight penalty from the pump. It delivers approximately 7.5 gpm at 3750 rpm. Applications are within normal operating range of 3000 to 3750 rpm. **New York Air Brake Co.**, Watertown Div., Watertown, N. Y.

Circle 913 on page 19

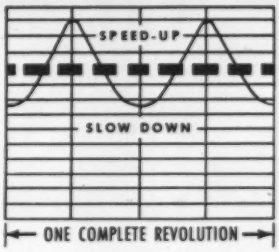
FACTS...

on a Universal Joint that cuts costs, increases production in steel-making equipment

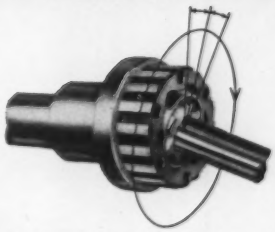




During rotation at a given angle, pin- or slipper-type joint speeds up, slows down twice during one revolution.



Solid line shows speed variation for one revolution of pin- or slipper-type joint at a critical angle. Note constant velocity of 100% for Rzeppa Joint (dotted line).



Due to its construction features, the Rzeppa Joint always transmits a smooth flow of power even at unbalanced angles. The standard joint cannot meet this test without involved compensating measures.

IN THESE TYPICAL APPLICATIONS

Among the many applications where Rzeppa Constant Velocity Universal Joints are ideally suited are:

- Blooming Mills
- Billet Mills
- Merchant Mills
- Skelp Mills
- Butt Weld Pipe Mills
- Electric Weld Tube Mills
- Hot Strip Mills
- Cold Reduction Mills
- Auxiliary Equipment

The above facts prove why you can expect superior performance when your steel-making equipment utilizes Rzeppa Constant Velocity Universal Joints. Rzeppa's *modern design* offers you all these advantages:

- INCREASED SPEEDS
- REDUCED DOWN-TIME
- LOWER MAINTENANCE
- HIGHER CAPACITIES

The next time you are considering universal joints for replacement or original equipment—why not look into the exclusive features offered only by Rzeppa.

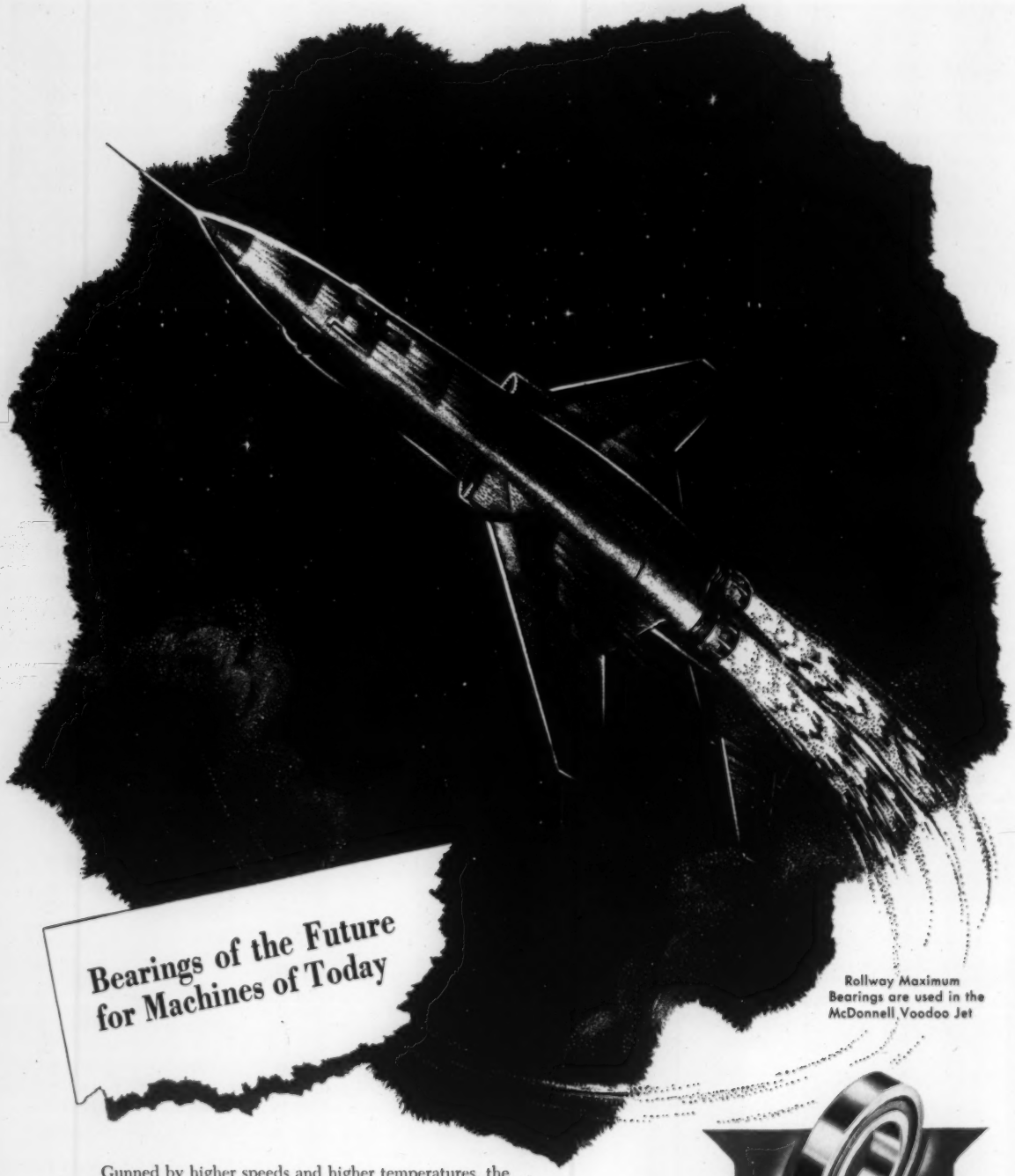
WRITE TODAY . . . for this complete brochure which offers you many more FACTS on Rzeppa Constant Velocity Universal Joints.

RZEPPA

("SHEPPA")
CONSTANT VELOCITY UNIVERSAL JOINTS

THE GEAR GRINDING MACHINE COMPANY
3937 CHRISTOPHER, DETROIT 11, MICHIGAN
Manufacturers of: Fully Automatic Gear Grinding Machines • THE DETROIT SCREWMATIC 750

Circle 591 on page 19



Bearings of the Future for Machines of Today

Rollway Maximum Bearings are used in the McDonnell Voodoo Jet

Gunned by higher speeds and higher temperatures, the performance demand for anti-friction bearings rises sharply every year. Here at Rollway, we strive always to keep abreast of the trend, and even to anticipate it. In precision, dimensional stability and simplicity, Rollway Maximum Bearings offer performance based on advanced thinking to original equipment and replacement buyers of today.

Start now, up-grade both your production machinery and your products with Rollway *bearings of the future.* Rollway Bearing Company, Inc., Syracuse 4, N. Y. Manufacturers of a complete line of radial and thrust cylindrical roller bearings.

ROLLWAY
Maximum
ROLLER BEARINGS

ENGINEERING OFFICES: SYRACUSE • BOSTON • CHICAGO • DETROIT • TORONTO • PITTSBURGH • CLEVELAND • MILWAUKEE • SEATTLE • HOUSTON • PHILADELPHIA • LOS ANGELES • SAN FRANCISCO

Circle 592 on page 19

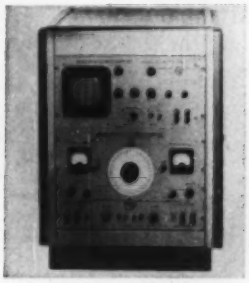
ENGINEERING DEPARTMENT

EQUIPMENT

Servo Analyzer

accepts carrier frequencies of 50 to 5000 cycles

Model F Servoscope provides sine, modulated sine and square-wave signals as well as the linear sweep on four ranges from 0.005 to 100 cps. It accepts carrier frequencies of 50 to 5000 cycles from the same



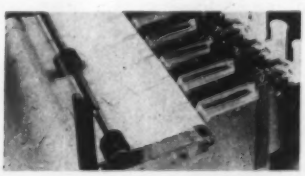
source used for the system under test. Measuring phase and gain change throughout the frequency range, unit is used in the laboratory for the design and test of servo systems and components. It is also used in production for inspection and quality control of systems and components. **Servo Corp. of America,** 20-20 Jericho Turnpike, New Hyde Park, N. Y.

Circle 914 on page 19

Oscillograph

uses three recording media

Dynagraph eight-channel, high-speed, direct-writing oscillograph permits the use of ink or electric-

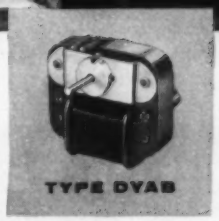


sensitive paper for curvilinear recording, or heat-sensitive paper for rectilinear recording. One medium

THE MARK OF QUALITY

BARBER COLMAN

Small Motors



TYPE DYAB

"We needed a quality motor to withstand marine environmental conditions."

Bendix Pacific Division, North Hollywood, Calif.

With the development of the new low-cost Bendix Depth Indicator, it is now possible for more owners of pleasure boats and commercial craft to equip for automatic depth indication. This indicator is available in two models: One with 480 soundings per minute for 50-fathom range, the other with 1440 soundings per minute for 100-foot range. For both models Bendix Pacific Division chose the Barber-Colman DYAB unidirectional motor, 115 volt, 60 cycle operated from a vibrator, to rotate the indicating light at a constant speed and actuate the unit's keying system. To withstand marine environmental conditions, these motors are furnished to Bendix with corrosion-treated rotors and stators and varnish-impregnated coils. If you have a design problem involving small motors, let Barber-Colman Company engineers help you solve it with the exact motor for the job.

FREE HELPFUL DATA SERVICE on the complete line of Barber-Colman small motors which includes unidirectional, synchronous, and reversible motors — up to 1/20 hp. With and without reduction gearing — open or enclosed types. Expert engineering service available. Write today, tell us your problem, ask for free data sheets and catalog F-4271-6, or see Sweet's Product Design File.

REVERSIBLE

SYNCHRONOUS

GEARED

UNIDIRECTIONAL

BARBER-COLMAN COMPANY

Dept. Q, 1273 Rock Street, Rockford, Illinois

Small Motors • Automatic Controls • Industrial Instruments • Aircraft Controls
Electrical Components • Air Distribution Products • Overdoors and Operators
Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Circle 593 on page 19

PRECISION PERSPECTIVE ....NEWEST WAY TO DRAW PERSPECTIVE—FAST, ACCURATE

If you can draw isometric—you can draw one, two, and three-point perspective in many different and varied positions with this completely new approach.

Maybe you'll find it hard to believe—but you can forget everything you've ever heard about so-called "perspective systems." The fact is that Precision Perspective is completely new and different in *theory* and *practice*.

Once you see and use it, you'll know you can say good-bye to all the problems and technical headaches of conventional perspective layout.

PAYS FOR ITSELF

Precision Perspective Grid Sets quickly pay for themselves in time saved—often on the first job. They can be used over and over again—you just slide them under your work sheet. All angular and dimensional calculating has been prefigured on Precision Perspective Grids. With a little practice, even untrained office personnel can render perspective drawings previously impossible for the unskilled.

Precision Perspective covers every factor that contributes to flexibility and accuracy. You cannot accidentally distort a drawing done on Precision Perspective Grids—purposeful distortion for effect is possible, when desired. This copyrighted system gives you infinite flexibility—a practical choice of many different positions from which to draw any subject, simple or complex, regular or irregular.

Professionals find they can now concentrate on the actual rendering of the perspective, rather than the time-consuming details of determining distances and directions to vanishing points and perspective distances.

SELECTOR CHART

With each Basic Set of Precision Perspective Grids you receive a Selector Chart and an illustrated Handbook. The Selector Chart enables you to see at a glance the exact angle desired for your finished drawing and tells you which numbered Grid position to use. The Handbook shows you exactly how to use the Grids. Both interior and exterior Grids are available in three sizes.

Ask your dealer for free, descriptive folder or write:
PERSPECTIVE, INC., 212 American Bldg., Seattle 4, Wash., Dept M

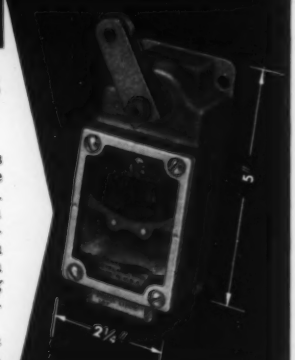
Circle 594 on page 19

Why leading manufacturers are "SWITCHING" WITH DENISON LOXSWITCH

HEAVY DUTY LIMIT SWITCHES

OVER 5,000,000 CONTACTS at 75 AMPS INRUSH and still operating!

Typical of the many reports we receive is this actual field experience of one of the "BIG THREE" automotive manufacturers. Results like this prove that Loxswitch switches have the reserve capacity necessary for emergency loads. It's the reason why Loxswitch outlasts all others as much as 5 to 1! Write for catalog 956 giving actual test data and choice of 21 circuits.



LOXSWITCH a registered trade mark for limit switches — pronounced lock-switch.

Specializing Exclusively in the Manufacture of Limit Switches.

R. B. DENISON MFG. COMPANY
102 ST. CLAIR AVE. N.W. • CLEVELAND 13, OHIO

Circle 595 on page 19

Engineering Equipment

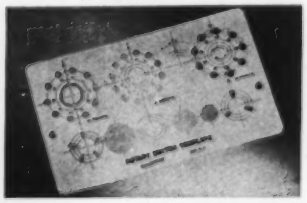
can be substituted rapidly for another. Unit is equipped with inkwells and with stylus heating facilities. Styli are interchanged when shifting from one medium to another and can be lifted from their cradles without use of tools. Chopper amplifier, which can be used for all applications, is free of drift and has a sensitivity of 15 μv per mm of pen deflection. **Offner Electronics Inc.,** 5320 N. Kedzie Ave., Chicago 25, Ill.

Circle 915 on page 19

Switch Template

for use in layout of wiring diagrams

No. 317 rotary-switch template assists in the schematic layout of wiring diagrams using rotary



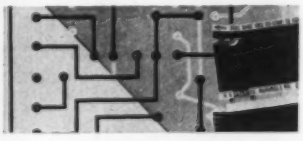
wafer-type switches. It covers 10, 12 and 18-inch switches, and can be used in other combinations by utilizing center holes as a rotating point. All cutouts are precision smooth. Made of #0.030-in. plastic, template measures 6⅜ x 3⅞ in. **Rapidesign Inc.,** Box 592, Glendale, Calif.

Circle 916 on page 19

Drafting Aids

speed making of printed-circuit layouts

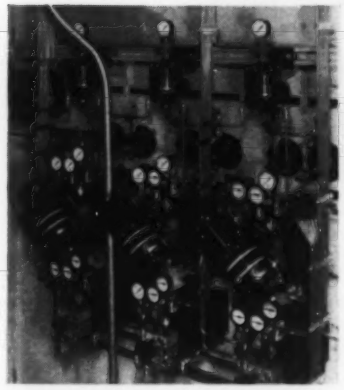
Black 'N White drafting aids are precut, self-sticking shapes and terminal strips for making layouts on clear or translucent film or cloth. Circuitry is laid out on both sides of the sheet. Ink-



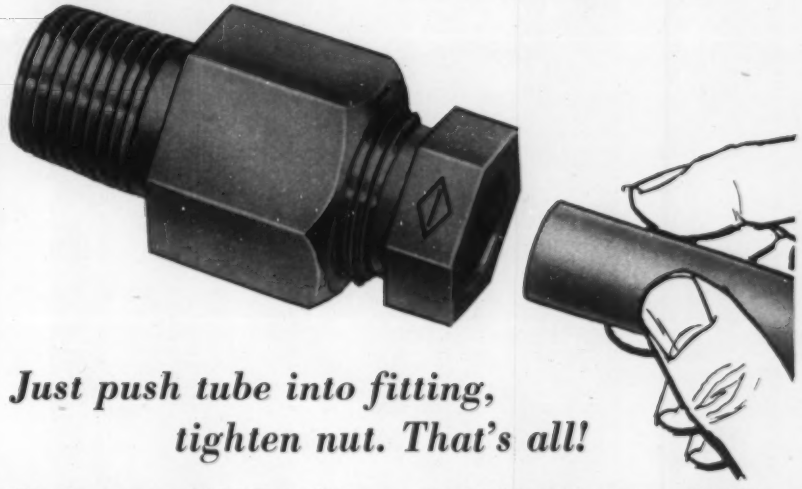
less prototypes and master layouts are made quickly with the shapes, available in graduated

Fast assembly boosts production rate

with IMPERIAL *Hi-Duty*® tube fittings



Rear view of a graphic panel used to control a Platform® Unit, built by Panellit Inc., Skokie, Ill.



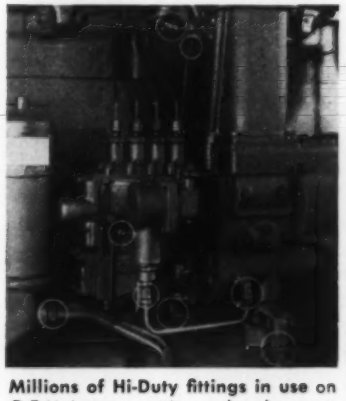
Just push tube into fitting, tighten nut. That's all!

Whether you use 10 Hi-Duty fittings or 500 per installation, seconds saved per fitting will quickly add up to man-hour profits!

Four-to-one edge over flared fittings – A man can easily assemble up to four Hi-Duty fittings in the time it takes to assemble *one* flare fitting. Spot tests show only 11.7 seconds on the average are required to install Hi-Duty as compared with 48.2 seconds for an ordinary flare fitting. A minimum 77% boost in efficiency for you.

One-third faster than compression fittings – Same tests showed Hi-Duty installation required only 11.7 seconds compared with an average of 18.5 for compression fittings. A boost of 36% in efficiency!

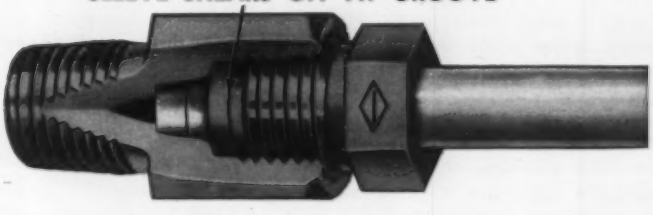
Hi-Duty joints absorb 5 times as much vibration as compression or flare fittings – Sleeve on Hi-Duty fittings shears off during assembly and becomes permanently attached to tube. Always remains in perfect alignment. Joints stay liquid-and-gas tight.



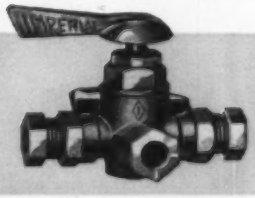
Millions of Hi-Duty fittings in use on O.E.M., instrumentation and replacement jobs. Hi-Duty fittings can be disconnected and reconnected repeatedly without danger of leakage. Extra-strong forged bodies on elbows and tees, long Dryseal pipe threads and generous hexes. Available in brass and aluminum. For use with copper, brass, aluminum, Bundyweld, GM, block tin, Monel and other metal tubing — ⅛ to 1" O.D.

For complete data, ask for Bulletin No. 3002.

SLEEVE SHEARS OFF AT GROOVE



Furnished in Brass and Aluminum



***Hi-Duty*® SHUT-OFF VALVES** – First choice for perfect fluid control! Positive shut-off. Solid bottom — no chance for leakage. Spring-loaded stem with "O" ring seal maintains proper tension on nickel-silver plug at all times. 2, 3 and 4-way types for low and medium pressures.

IMPERIAL

THE IMPERIAL BRASS MFG. CO.
513 S. Racine Ave., Chicago 7, Illinois
In Canada: 334 Lauder Avenue, Toronto, Ontario

Emblem of Quality

SEE YOUR IMPERIAL DISTRIBUTOR – he carries the industry's most complete line of tube fittings and tubing tools.

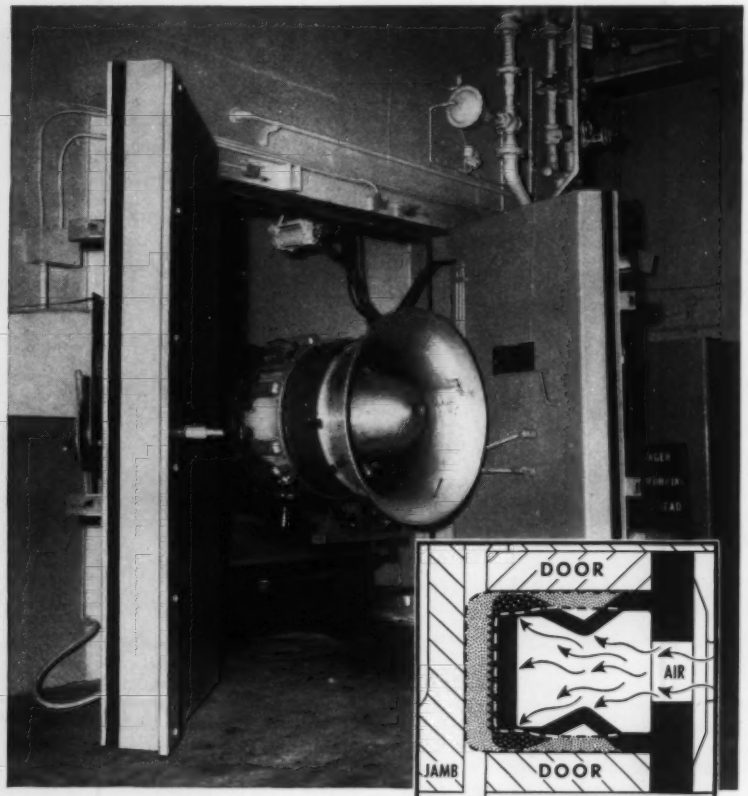


Photo courtesy General Electric Co.

Dotted area shows gasket inflated

Pneumatic Rubber *Door Seal* Muffles Test Cell Noises

To more effectively suppress noise, General Electric jet engine test cells are equipped with a unique pneumatic rubber door seal. Mounted on door perimeter, this seal is designed to expand proportionally and insure a perfect seal over its entire sealing surface *including the corners*. Not only does this gasket dampen the noise but it permits more accurate testing through quieter working conditions.

Continental engineers developed this pneumatic gasket for this and similar applications. Compounded of special flex-resistant rubber, this versatile gasket can be operated with intermittent flexing cycle *or* as a continuous seal—can be adapted to various other types of doors—for *either* pressure or vacuum rooms.

The design of this gasket typifies the engineering skill offered by Continental. When you need "engineered rubber parts"—molded or extruded—enlist the service of specialists—consult Continental.

Engineering Catalog.

In addition to custom-made parts, Continental offers an extensive line of standard grommets, bushings, bumpers, rings and extruded shapes. Hundreds of these are shown in the No. 100 Engineering Catalog. Send for a copy or refer to it in Sweet's Catalog for Product Designers.

Another achievement in **RUBBER**
engineered by **CONTINENTAL**

CONTINENTAL RUBBER WORKS • 1984 LIBERTY ST. • ERIE 6 • PENNSYLVANIA

Circle 597 on page 19

Engineering Equipment

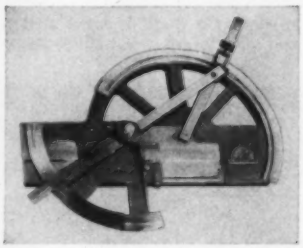
sizes of 1/10-in. and fractional increments. Angles, curves, ellipses and circles can be made quickly; elbows, tear-drops, fillets and circles are available in a range of sizes. **W. H. Brady Co.**, 727 W. Glendale Ave., Milwaukee 9, Wis.

Circle 917 on page 19

Angle Calculator

speeds solution of triangle problems

Triangulator produces unknown co-ordinates of any triangle by direct visual reading of sides and angles of triangle as setup on in-



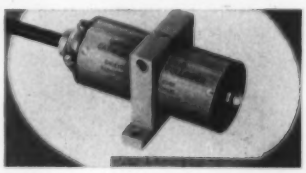
strument. Vernier scales provide linear settings to three decimal places; protractor vernier provides angular settings to one minute of arc. Unit speeds solution of problems involving right or oblique triangles. **Fitch Instruments Inc.**, 1480 E. Hight St., Pottstown, Pa.

Circle 918 on page 19

Vibration Test System

operates in temperatures to 500 F

System, consisting of an accelerometer, a cathode follower and connecting cable, is designed to operate in ambient temperatures to 500 F without cooling or correc-



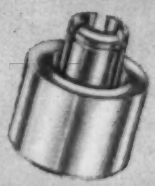
tion. Accelerometer provides a minimum sensitivity of 8 mv per g for high signal-to-noise ratio, even at low g levels. Cathode follower, together with the all-Teflon, noise-treated connecting cable, can be used in 500-F temperatures close

HOW MANY WAYS CAN *Special Purpose Fasteners* CUT COSTS FOR YOU?

How many of your products employ laborious, old-fashioned fastening methods where simple fasteners could do the job and cut costs, too? How many parts and sub-assemblies can be adapted to include a self-fastening feature? How many future products could be improved by advance planning for fastener efficiency?

United-Carr's engineering staff offers you a wealth of experience in the design of special-purpose fasteners and self-fastening devices. Large-scale manufacturing facilities (including in-plant plastics molding equipment) ensure economical, *volume* production and prompt deliveries. United-Carr field representatives are ready to call on you at *your* request.

POLYETHYLENE MOUNTING FOOT



No mar, no scratch glide for use on TV receivers, record changers, small appliances, etc. Assembles into round hole in wood or metal cabinets.

NYLON SNAP-IN NUT

Snaps into square hole stamped out of sheet metal . . . provides secure anchorage for any sheet metal or self-tapping screw . . . highly effective electrical insulator.

QUICKEY FASTENER

Eliminates need for welding or swaging studs to sheet metal stampings, facilitates nesting, eliminates damage in transit because Quickey snaps in before final assembly.

THREAD CUTTING FASTENER

Re-usable, self-locking, vibration-proof fastener cuts clean, deep threads on unthreaded chrome-plated studs. Available for ⅛", 3/16" and ¼" studs.

PLUG BUTTONS

Snap into ⅛" to 3" dia. holes. Can be embossed with ornamental or functional designs . . . various finishes, shapes and sizes.

FISHTAIL RATCHET PLATE

Holds on smooth, die-cast metal or plastic studs to anchor name plates, trade marks etc. on appliances, automobiles, electronic apparatus, etc.

TRIMOUNT STUDS

Hold two or more thicknesses of material together. Easily installed by hand. Insure vibration proof attachment. Permanent or removable. Many shapes and sizes.

V-LOCK TEENUT

Re-usable, self-locking, one-piece, all-metal nut has high tensile strength, is unaffected by heat or oils. In various shapes, sizes and metals.

SOL-A-NUT

Self-locking, rustless, heat resistant. Sturdy, one-piece stainless steel construction prevents corrosion if nicked or scratched.

DURABLE DOT FASTENER

Snap fastener for cloth, leather, plastics and other materials. Positive closure, instant release. Black, nickel or brass finish.

CARR FASTENER COMPANY

Division of United-Carr Fastener Corp., Cambridge 42, Massachusetts

MAKERS OF DOT FASTENERS

Circle 598 on page 19

SEALING DOMESTIC APPLIANCES IS A REAL CHALLENGE, TOO!
Limited axial room and large diameter are mechanical requirements in this washing machine seal. Design features multiple spring construction for even face loading.
FIVE ADAPTATIONS OF THE John Crane
TYPE 6A SEAL
for four different appliance manufacturers
Standard 6A Seal with specially designed seat conforming to impeller contour so as to promote good water flow characteristics.
Seal features outer periphery face construction to best service garbage disposal conditions.
Two sealing points in a washing machine with widely differing physical limitations, yet seals for both retain full advantage of diaphragm action, shouldering points and positive drive.

Soapy water, detergents, bones, grit and lint . . . all these combine to make appliances a hard-to-handle sealing problem. Add that to a very limited space factor, and you've got a real set of conditions on your hands.

"John Crane" engineers have solved these problems and thousands of other shaft sealing applications on all types of commercial and industrial equipment. We know that we can be of the same help to you.

That's why . . . as one design engineer to another . . . we urge you to let us work with you in adapting or developing the proper seal for your application.

See us at the Design Engineering Show, Booth 1042. Tell us about your requirements and request Bulletin S-204-3.

Crane Packing Company, 6425 Oakton Street, Morton Grove, Illinois, (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

Engineering Equipment

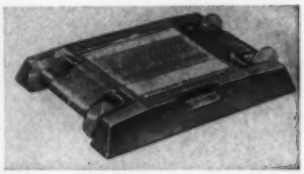
to accelerometer to avoid loss of signal caused by long cables. Electronic parts of cathode follower are hermetically sealed in inner housing which is vibration-isolated from outer case, providing low noise system. **Endevco Corp.**, 161 E. California St., Pasadena, Calif.

Circle 919 on page 19

Oscillograph Viewer

for quick viewing of oscillograph records

Viewpak, a simple, portable unit, is available for on-the-spot quick viewing of oscillograph records. It has a motorized paper drive, 16 x 18-in. back-lighted viewing area,



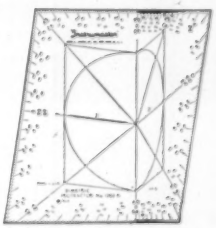
and handles records up to 16 in. wide in rolls to 7½ in. diam. Linear speed of the paper is varied by a foot pedal between zero and approximately 96 ips in either direction. Mechanical brake enables record to be stopped quickly but still maintains tension across the viewing area. Unit can be tilted up for semivertical viewing. **Benson-Lehner Corp.**, 11930 Olympic Blvd., Los Angeles 64, Calif.

Circle 920 on page 19

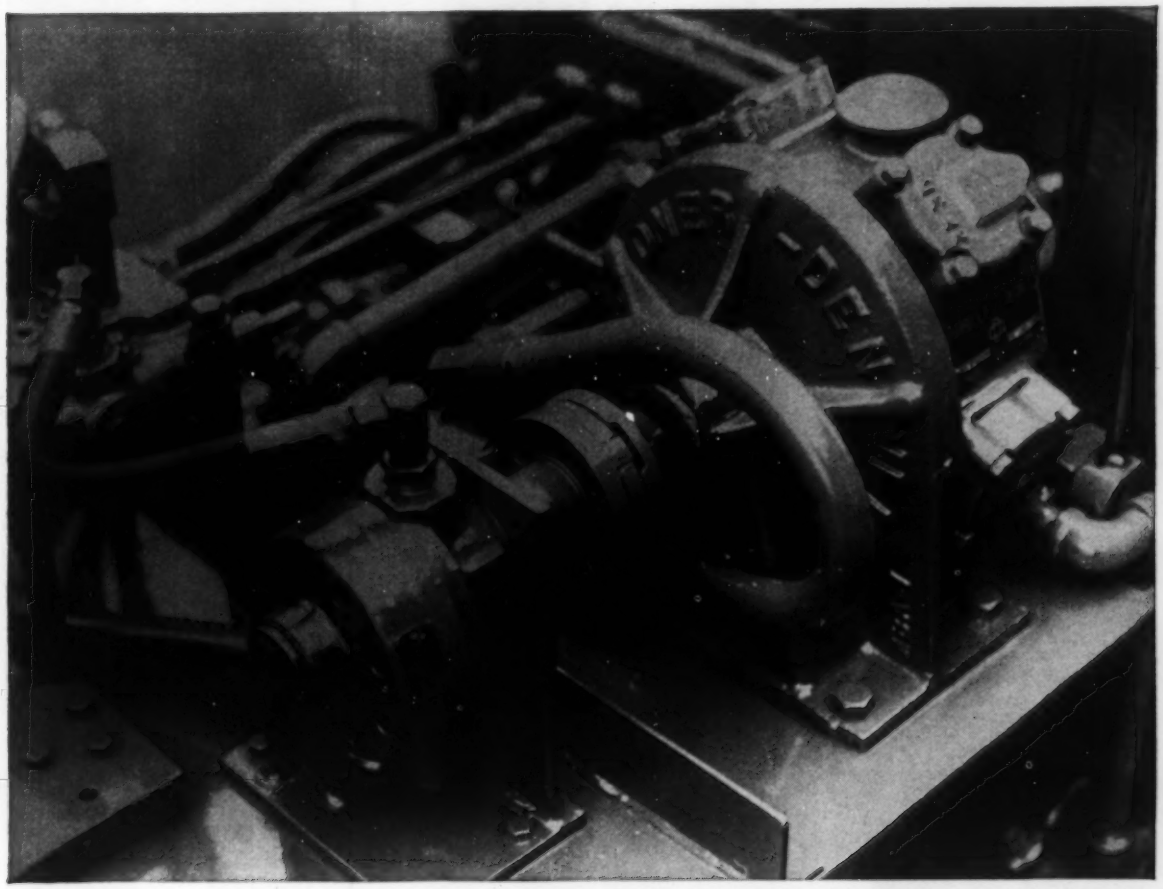
Dimetric Protractor

for axonometric drawing

Protractor, No. 1202-A, conforms to the dimetric ellipse based on a scale ration of 1:1:0.5. It is clear Vinyl stock and contains graduations for the two different scale sec-



tions of the dimetric system and the numerals covering 90 deg from a zero mark both in clockwise and



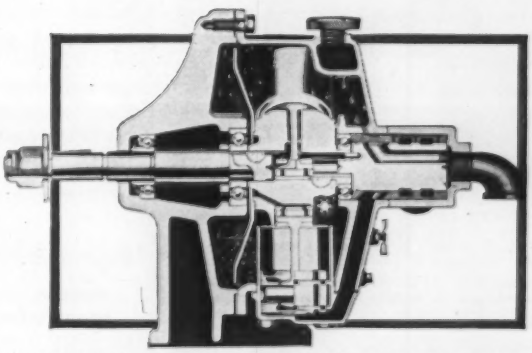
Gardner-Denver 5-cylinder radial air motor powers hydraulic pump.

Cool power . . . with a lot of hot uses

Gardner-Denver air motors stay cool even when stalled by overloads. They stay cool under constant starting, stopping, reversing. They do not spark.

These 5-cylinder radials offer you from 3 to 15 hp, almost constant high torque, ready control. They're tolerant of dust and gases. Some of the hot uses already found for them are in bit grinders, bending rolls, chain saws, concrete mixers, blowers, pumps, hoists, conveyors, engine starters—to name just a few.

These motors are stocked in geared or direct drive models, reversible or nonreversible. Send for descriptive bulletins.



Gardner-Denver 5-cylinder radial air motors are designed for rugged service, built with precision of top-quality materials, proved in years of service. Specify with confidence.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER - DENVER

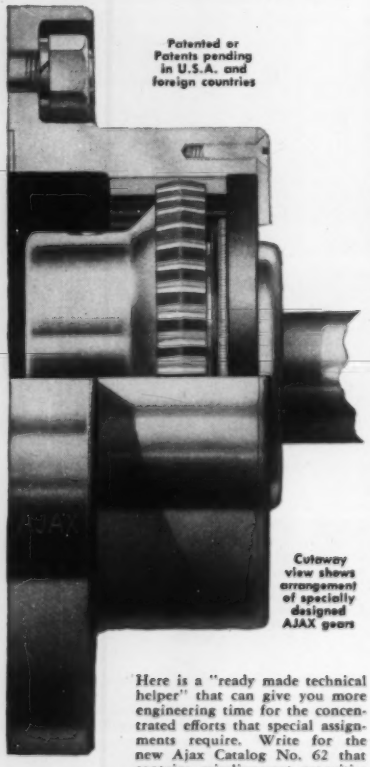
Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

AJAX

Self-aligning

DIHEDRAL COUPLINGS

Give Design Engineers An Immediate Source of Product Improvement



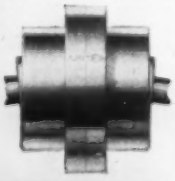
Patented or Patents pending in U.S.A. and foreign countries

Cutaway view shows arrangement of specially designed AJAX gears

Here is a "ready made technical helper" that can give you more engineering time for the concentrated efforts that special assignments require. Write for the new Ajax Catalog No. 62 that contains misalignment capacities of every coupling size and type in the complete line of Ajax Dihedral Couplings. Why spend valuable time duplicating data already established by thousands of proven, field tested applications.

Ajax Dihedral Couplings handle unavoidable shaft misalignment, angular and offset, up to a total of 12°. Teeth can be cut to handle greater misalignment capacities on special order.

Get the facts on how manufacturers of presses, machine tools, rolling mills, cranes, earth moving and many other direct connected machines are simplifying design, cutting manufacturing costs and improving product performance with Ajax Dihedral Couplings.



Write today for your personal copy of Bulletin No. 62.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, NEW YORK

Circle 601 on page 19

Engineering Equipment

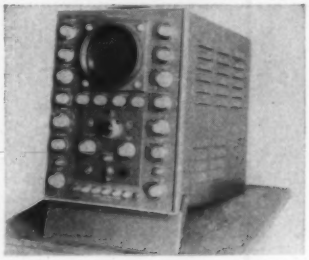
counterclockwise direction. A second set of numerals is provided in reversed figures, so that numerals can be read directly in regular as well as in reversed position of protractor. **John R. Cassell Co. Inc.**, 110 W. 42nd St., New York 36, N. Y.

Circle 921 on page 19

Oscilloscope

for general purpose laboratory work

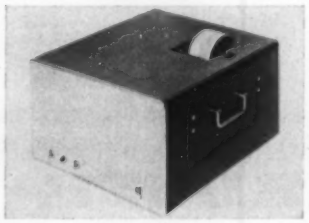
Redesigned Model 411A oscilloscope has improvements in vertical channel, high-voltage supply and ventilation system to provide better synchronization between signal and trace, better amplitude response and better long-term reliability. Unit is a general-purpose, precision laboratory-type instrument. It has a bandwidth of dc to 10 mc and sweep speed range of 0.1-microsecond to 0.1 second per cm. Six plug-in units, such as sweep delay, gated marker generator and dual trace, provide versatility in application. **Laboratory for Electronics Inc.**, 75 Pitts St., Boston, Mass.



Circle 922 on page 19

Digital Printer

records electronic count information



High-speed digital printer features rapid read-out, parallel entry and up to 12-digit printing. Record is

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**Penton Building
Cleveland 13, Ohio**

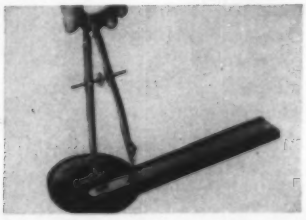
printed on standard adding-machine tape. Display time is 0.2 second minimum; maximum is controlled by counting instrument. **Computer - Measurements Corp.**, 5528 Vineland Ave., North Hollywood, Calif.

Circle 923 on page 19

Divider Setter

permits accuracy in setting to 0.001-in.

Micro divider setter is equipped with silver-plated vernier scale which permits accuracy in setting to 0.001-in. Rule is finished in hard



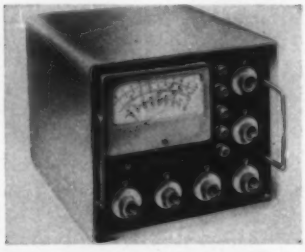
chromium plate with nonscratch surface, affording adequate protection from rust and corrosion. Unit is furnished complete with case. **Air Transport Equipment Inc.**, Albany Ave., Amityville, N.Y.

Circle 924 on page 19

Power-Transient Analyzer

measures voltage, frequency and KVA

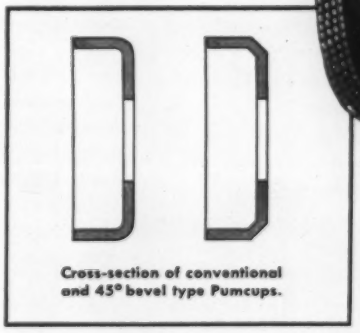
Compact, portable analyzer simultaneously measures, displays and records generator output voltage, frequency, wave form and power.



Voltage and frequency error is under 0.1 per cent and under 1 per cent for constant phase to neutral-voltage KVA output. **American Machine & Foundry Co.**, Defense Products Group, 1025 N. Royal St., Alexandria, Va.

Circle 925 on page 19

2-way gain with PUMCUPS



Cross-section of conventional and 45° bevel type Pumcups.

Darcova Pumcups are available in various types and textures, in a complete range of sizes, to provide unequalled efficiency and long life in reciprocating pumps, air or hydraulic mechanisms.

★ prolonged high efficiency
★ less maintenance

TODAY hundreds of companies using hydraulic controls, air cylinders or reciprocating pumps are *standardizing* on Darcova Pumcups for piston packing, because they eliminate fluid slippage, costly down-time and maintenance.

Darcova Pumcups make the *most* of the cup packing principle. And, they are made in a complete range of sizes, types and texture-engineered compositions for various pressure-temperature-fluid conditions. Pumcups hold peak efficiency for the life of the cups and outlast other packing as much as 3 to 1.

Why not check these claims right in your own plant? Meanwhile get *all* the facts. Just send for Pumcup Bulletin No. 5503.

DARLING VALVE & MANUFACTURING CO.
Williamsport 30, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

Circle 602 on page 19

FROM DENISON

How Caterpillar designs rugged hydraulic efficiency into Traxcavator

with Denison's new 2000 psi vane-type hydraulic pump

● Rugged dependability and high operating efficiency have been engineered into Caterpillar's new No. 977 Traxcavator with Denison's balanced-vane hydraulic pump.

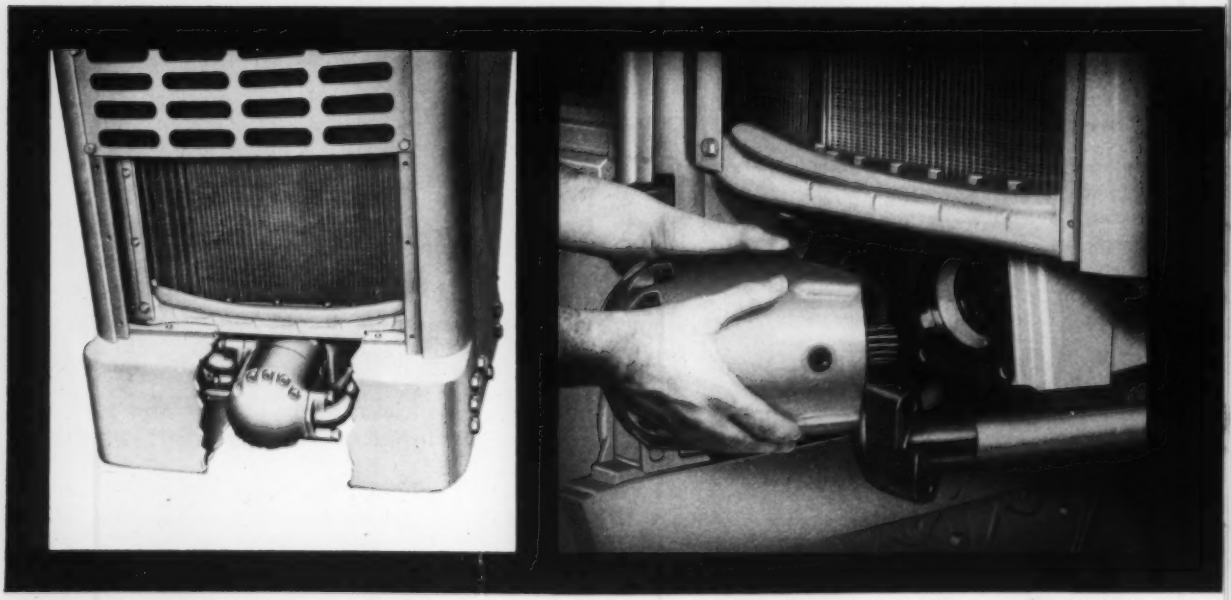
Capable of delivering continuous 2000 psi service, the Denison pump powers the Traxcavator's lifting arms—the real workers on construction equipment of this type. The pump contributes these important design features.

Packs more power . . . 50 h.p. in less space than a conventional 3 h.p. electric motor where weight and space are a premium.

Cold-weather starting . . . under severe weather conditions, to help maintain construction schedules, avoid costly delays.

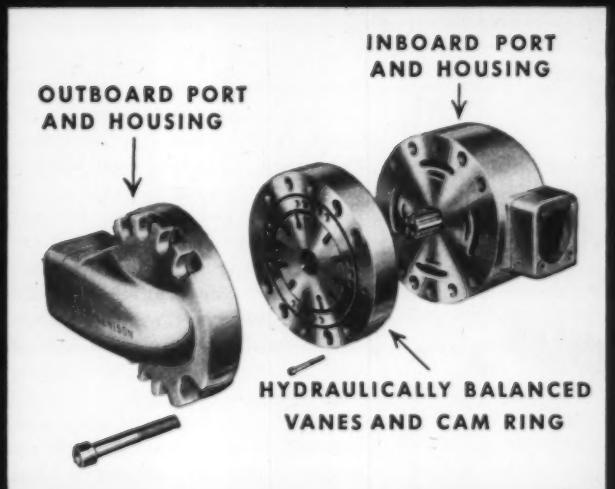
Fast on-the-job servicing . . . pump easily removed and replaced as a unit without special tools or skills.

Long, efficient life . . . fully-balanced vanes and rotors reduce wear on cam rings and thrust plates to give long pump life with minimum maintenance. Internal friction is lower, volumetric efficiency higher. In the Traxcavator, the pump is operated at 1700 psi, further increasing its lifespan.



Denison 2000 psi vane-type hydraulic pump, located at front of engine, is driven through a universal joint.

Complete pump is removable as a unit to simplify servicing in the field. Special tools or skills are not required.



Denison's exclusive cartridge construction. Rugged, specially designed vanes provide dual sealing edges between vane and cam ring.

***NEW* BULLETIN 200** describes how Denison's 2000 psi hydraulic pump can improve the design and operation of all types of mobile equipment and machinery. Write Denison Engineering Division, American Brake Shoe Co., 1240 Dublin Road, Columbus 16, Ohio.

DENISON HydrOILics

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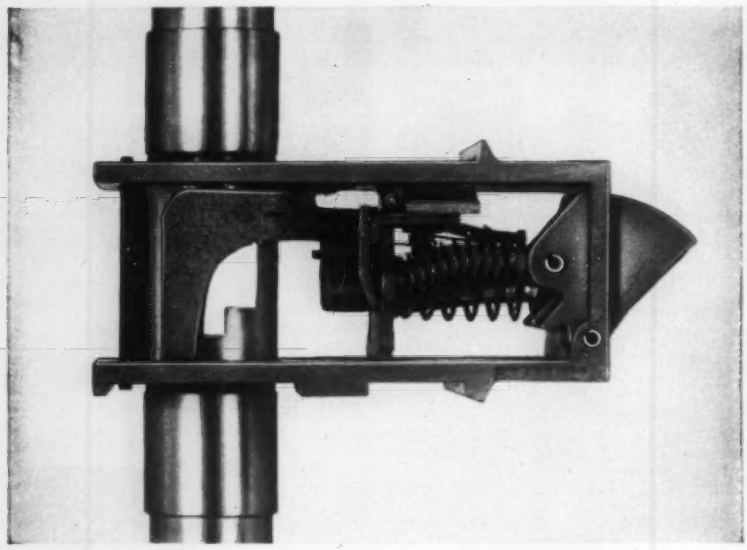
Circle 603 on page 19

FASTENER PROBLEM



Lower hinge pin assembly cost for Corbin and Russwin locks

The American Hardware Company previously used solid steel hinge pins in the latch release mechanism of their line of door locks. However, in assembling the locks it was necessary to ream the holes for the pins and to stake them into place, which added to the assembly costs of the solid steel pins.

Stainless Steel Rollpin® drastically cut the cost of the hinge pin assembly because Rollpin is easily driven into standard drilled holes without reaming and the secondary staking operation was entirely eliminated. Rollpin compresses as driven, and its spring action locks it securely in place against vibration.

This simple fastener cuts cost in an infinite variety of applications. Rollpin quality control can be depended upon to guarantee uniformity in shear strength, hardness, dimensioning and high performance. Why not consider the opportunities it offers you for substantial savings as a locating dowel, rivet, clevis pin, or in place of set screws, tapered or grooved pins.

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Dept. R39-54, Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free fastening information:

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☐ Here is a drawing of our product. What self-locking fastener would you suggest?

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Stress Relief

ONE OF the biggest things in the engineering profession in recent years is the changing status of the engineer and the increased value put on his services. In a recent conversation with J. P. Henderson, we expressed some wonder that he had not burst forth on this subject. Here now are some of his various thoughts on the changing scene.

Money Isn't Everything!

From the attitude that technical brains were worth a dime a dozen, the young engineer now finds himself in a society that woos him avidly and pays him a larger salary. (Almost half of what a good salesman earns.)

It's a big change. But is it good for either the individual or the organization employing technical people?

As for me, being retired and off the firing line, I'm thankful I no longer have the problems described to me recently by some of my friends.

Says one: "I've been putting the rest of the management through a continuous series of shock treatments for the past five years. They began when I had to start paying $300 per month for college graduates. At that time I predicted that a young engineer right out of college couldn't be touched for less than $5000 per year, within the close future. And I was almost thrown out of the president's office for making such a silly statement.

"Well, we got several good men this past year and paid $425 per month. In my arithmetic that is over $5000 per year. Naturally we had to advance salaries pretty well up the line and my engineering budget has soared.

"Even with sales increases over the past five years, my engineering expenses have increased percentagewise more than sales. I'm

how **Maxitorq** Floating disc clutches

helped MICHIGAN TOOL design push-button speed and versatility into new "king-size" gear shaver

The two MAXITORQ Double Clutches tucked so compactly into the main-drive gear-box on Michigan Tool's Model 885 Gear Shaver permit simple, positive, finger-tip selection of four speed ranges, infinitely variable, with a low of 1.3 to a high of 166.4 r. p. m. They are an important key to this new machine's outstanding features of versatility, speed, quick change-over, and push-button control.

Machine tool and industrial equipment designers find in MAXITORQ Floating Disc Clutches the essentials of COMPACT design and instant positive engagement and disengagement . . . freedom from drag or heating in neutral and full power transmission . . . that are so important to the success of installations such as these. MAXITORQ Floating Disc Clutch design and *performance* have been PROVED by many years of service under all conditions.

Outstanding advantages of MAXITORQ Floating Disc Clutches for machine tool and equipment drives also include RUGGED SIMPLICITY of all parts . . . MINIMUM EFFORT for engagement and disengagement . . . EASY MANUAL assembly, disassembly and adjustment. Available in a full range of sizes in SINGLE, DOUBLE and AUTOMATIC OVERLOAD RELEASE types.

For full information, write Dept. MD-5.

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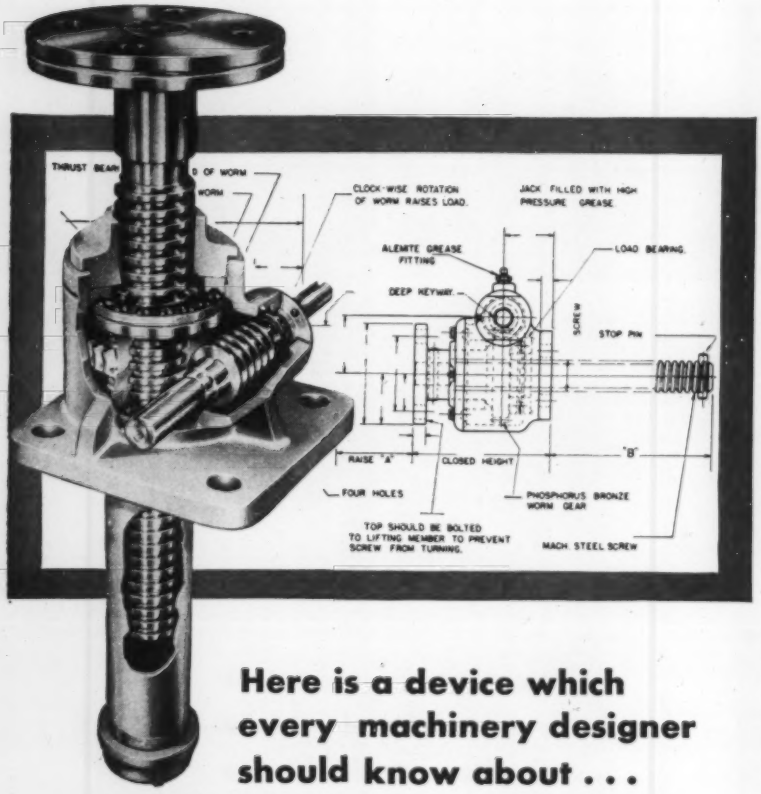

Here is a device which every machinery designer should know about . . .

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Duff-Norton worm gear jacks provide a purely mechanical means for accurate positioning of loads weighing as much as several hundred tons and maintaining them indefinitely without creep. They will operate in any position, and functioning as components of machinery and equipment they can raise and lower loads, apply pressure or resist impact. Jack capacities range from five to 50 tons. When two or more jacks are connected by means of shafting and mitre gear boxes they lift in unison, even when the load is unevenly distributed. They are available with standard raises up to 25 inches, and will provide exactly the same raise for years without adjustment. Worm gear jacks are suitable for operation at ambient temperatures up to 200°F.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, arbor presses, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting bulletin AD-34-V, which includes drawings and full specifications.

See these jacks at the Design Engineering Show—Booth 1704

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Stress Relief

in the doghouse."

"Suppose," I said to him, "you forget about yourself as an executive and think about engineering in general. Are you glad to see the engineering profession advance in salary?"

"I guess I am. After all, most managements are money-minded. Things or people are valued by what they cost. Probably the engineering profession will gain stature by this trend."

Another friend of mine is less optimistic:

"The present setup is neither good nor healthy. The expectant graduate is wooed like a bride-to-be and then surprised and shocked to find that he is expected to work hard, and really produce.

"Some of them readjust. Some of them move.

"I have heard of organizations doing business largely under government contract who have engineers falling all over each other. One in a half dozen really does engineering work while the rest try to look busy or, at best, have duties on a technician's level. How productive are these engineers ever going to be when they do move out into competitive industry?

"It's all very unhealthy, I think, and there will ultimately be a big shakedown."

A third friend explained a situation that I've heard about from a number of sources.

"I'm sitting on a keg of dynamite. Our organization has a well established policy of salary rates and they have been boosted in recent years in a realistic manner. But they haven't been raised enough to accommodate a $100 increase in starting salary rates in the past four years or so.

"As a result I have young engineers in the $450 group who will soon be crowding $500. But I also have men who have been with us ten years who make only $500—some slightly less, some around $600.

"Based on their starting rates and regular increases, their salaries seem fairly reasonable.

"Is a man with ten years' experience worth at least twice as

GREGORIO JARQUE and SON demonstrate the little sheave with the big grip

Easy on Bruce Jarque uses a standard wrench to assemble.

Easy off Two pull-up screws are used to break the cone grip.

Yet always tight on the shaft
Gregorio Jarque is no match for the QD Junior.

Exclusive tapered, split hub on Worthington QD Junior sheave grips the shaft so tightly it can't be dislodged

This two-piece, light-weight sheave has a heavyweight's grip. An exclusive tapered, split hub grips the shaft so tightly wrestler Gregorio Jarque can't dislodge it. Tests show the Worthington QD Junior will remain tight even under a torque force of 3300 pounds.

It's built for staying power—won't loosen or slip under shock or pulsating loads. Yet it's always easy to remove from the shaft.

Some other money-saving features of the QD Junior:

One Common Hub is standard for 54 stock sheave sizes, ranging from 3.2 to 18.4 inches pitch diameter.

Tapped Holes allow use of pull-up bolts as jack screws to break cone grip when removing rim from hub.

Heavy Hex Head Bolts fasten rim to hub. No special tools are required to remove or install the QD Junior. A standard hex socket wrench is all that's needed.

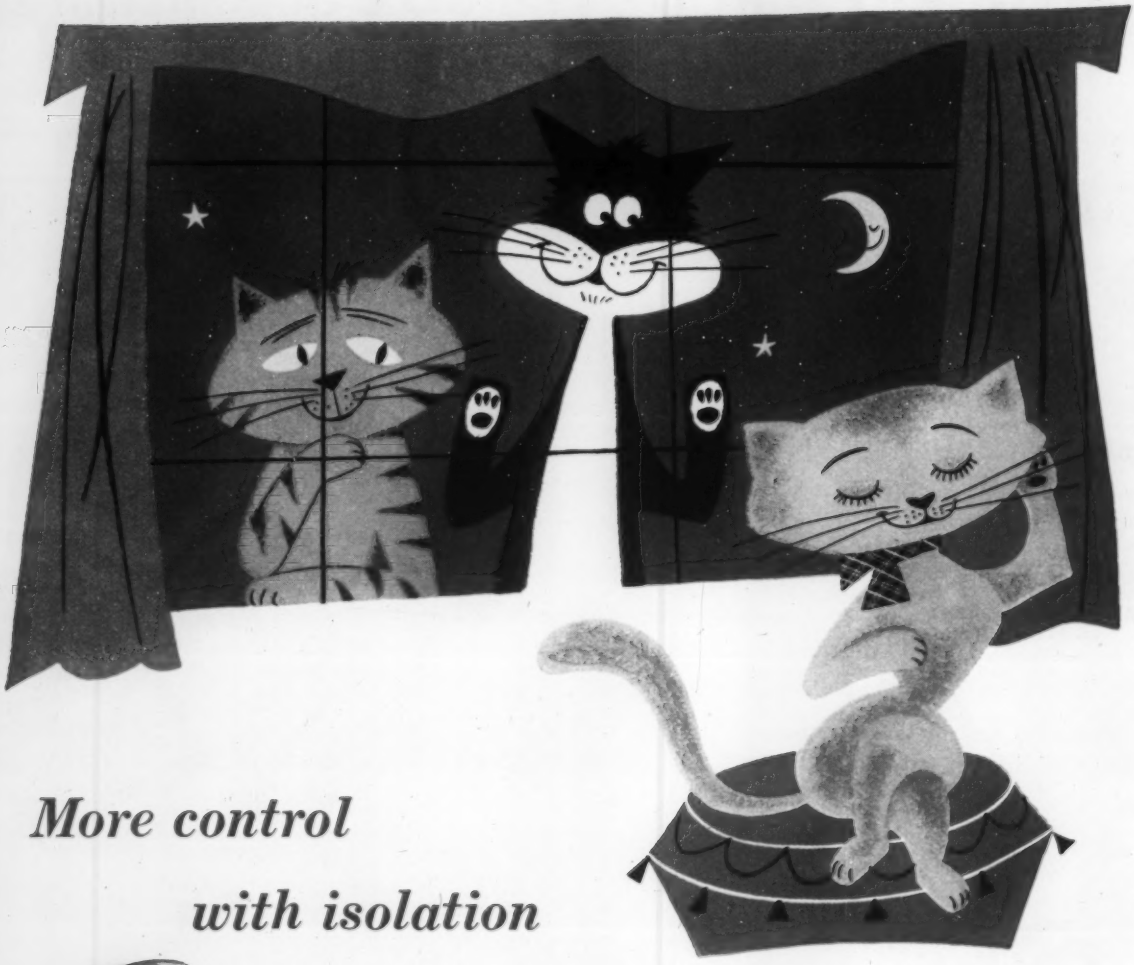
I-beam Arm (in larger sizes) gives more strength with less weight.

You'll find it's easy to select the proper light-weight sheave and FHP V-belt drive from bulletin FHP-100-B1A. Write for your copy today. Worthington Corporation, Section MV65, Oil City, Pa.

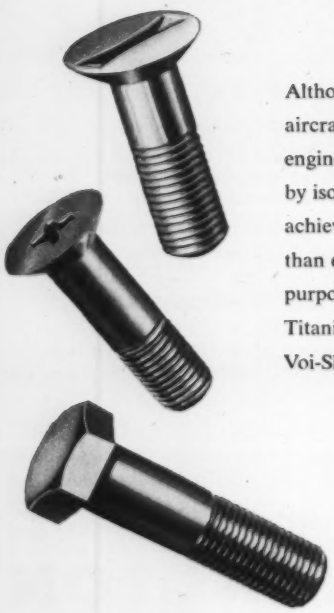
MV-6.5

WORTHINGTON

Circle 607 on page 19



More control with isolation



Although Titanium is one of the most challenging metals ever presented to the aircraft industry, its fabrication into dependable fasteners requires extensive engineering and quality control. Voi-Shan, one of the pioneers in the field, decided that by isolating their Titanium production into a separate division, they would achieve a greater concentration of engineering, production and quality control than ever before possible. A separate, modern plant has been acquired for this purpose. It also means better service and greater facilities for solving your particular Titanium fastener problems. Why not submit your Titanium needs to your local Voi-Shan representative, or write for the booklet, "Voi-Shan Reports on Titanium."

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Circle 608 on page 19

much as a newcomer? If so, that means that every one of our ten-year engineers should be getting $800. Believe me, few of them are."

I interrupted. "You said something about a keg of dynamite. I didn't know it came in kegs."

"Never mind," he said. "The explosion could come from my older employees who aren't quite aware that the two and three-year engineers are crowding them so closely. When something occurs to bring this out clearly, I'm going to have a mighty unhappy organization.

"Fortunately most of our newer men are in the home office, with the older ones in the district offices. It's those miles in between that help prevent a chain reaction."

I've heard of some about-to-be graduates who have not always taken the job offering the most money. Some of them do weigh future opportunity and challenge against the quick dollar. But it must be a temptation.

Of course, money isn't everything. Have you heard of the cynical, retired politician who addressed a graduating class? After speaking of the challenges ahead he wound up by saying:

"Money isn't everything! It won't buy position. It won't buy respect and honor. It won't buy happiness."

And then after a pause he added: "Not Confederate money, that is."

—J. P. HENDERSON

"Where the heck's my detailer?"

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- Shaft sizes—¾" to 1⅞".
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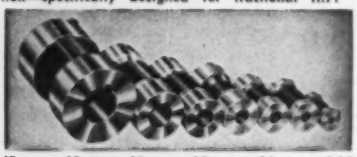
The finest flexible coupling in single unit construction—specifically designed for fractional H.P.



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- Allows 7° angular deflection.
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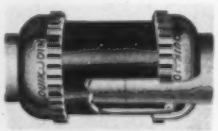

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Circle 610 on page 19

THE ENGINEER'S

Library

Recent Books

Patent Notes for Engineers, Seventh Edition. *By C D. Tuska; 192 pages, 6 by 9 in., clothbound; published by McGraw-Hill Book Co. Inc., 330 West 42nd St., New York 36, N. Y.; available from* MACHINE DESIGN; *$4.00 postpaid.*

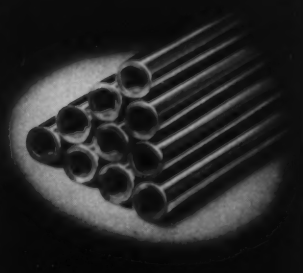
This manual bridges the technical gap between engineers and inventors and their patent attorneys. It gives an idea of what patentable inventions are, how to protect them, and employer-employee relations in patent matters. Case histories and court decisions are quoted frequently, and patent illustrations, disclosure drawings and sample application forms are shown. The book explains how applications are prepared, filed, and acted upon, and what happens when applications of rival inventors are placed in interference.

Elements of Engineering Thermodynamics. *By Rolf H. Sabersky, associate professor, California Institute of Technology; 318 pages, 6 by 9 in., clothbound; published by McGraw Hill Book Co. Inc., 330 West 42nd St., New York 36, N. Y.; available from* MACHINE DESIGN, *$7.50 postpaid.*

This text develops the principles of thermodynamics; the basic laws are stated, and their experimental foundations are discussed. In deriving consequences from the basic laws, the assumptions are emphasized. The book distinguishes clearly between the basic laws and the derived relationships which are valid in more restricted cases only.

Applied Strength of Materials. *By Alfred Jensen, professor, University of Washington; 343 pages, 6 by 9 in., clothbound; published by McGraw-Hill Book Co. Inc., 330 West 42nd St., New York 36, N. Y.; available from* MACHINE DESIGN; *$5.75 postpaid.*

This book discusses the strength and other properties of various engineering materials and how to de-



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Circle 611 on page 19

sign various types of structural members and connections commonly found in engineering. The developments of all design formulas have been accomplished without the use of calculus. The book gives explanations of existing physical relationships and of the relationships of cause and effect, action and reaction.

A strong emphasis is placed on the actual design of structural members, parts, and connections. One chapter gives a discussion of methods of manufacturing and properties of various engineering materials.

An Introduction to Junction Transistor Theory. *By R. D. Middlebrook, electrical engineering department, California Institute of Technology; 296 pages, 6 by 9 in., clothbound; published by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, N. Y.; available from* MACHINE DESIGN; *$8.50 postpaid.*

This book serves as a connecting link between the physical processes in semiconductors and the circuit properties of a junction transistor, forming a bridge between physics and engineering. The major purpose of the book is to provide a continuous development of basic junction transistor theory, starting from fundamental physical principles and closing with practical circuit representations. It presents a practical equivalent circuit which represents the small-signal behavior of a junction transistor over its useful frequency range as an amplifier.

Bearing Design and Application. *By Donald F. Wilcock and E. Richard Booser, General Electric Co.; 464 pages, 6 by 9 in., clothbound; published by McGraw Hill Book Co. Inc., 330 West 42nd St., New York 36, N. Y.; available from* MACHINE DESIGN, *$12.50 postpaid.*

This is a practical guidebook for the designer in selecting and designing bearings, with emphasis on selection and calculation methods for integrating the bearing design, bearing material, and lubricant into a workable unit.

Among the subjects covered are analysis of load capacity, speed, temperature, dimensional tolerance,

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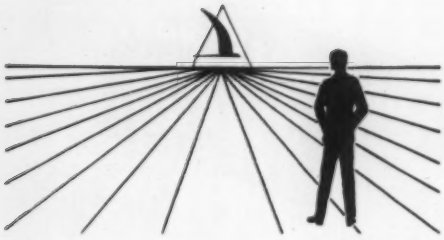

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and lubrication factors in selecting ball and roller bearings; combination of the latest digital-computer analysis with bearing material and lubricant selection in hydrodynamic journal and thrust bearings; reciprocating-bearing design methods for automotive and diesel use; and lubrication-system designs.

Electric Circuits and Machines. *By B. L. Robertson and L. J. Black, professors of electrical engineering, University of California; 456 pages, 6 by 9 in., clothbound; published by D. Van Nostrand Co. Inc., 120 Alexander St., Princeton, N. J.; available from* MACHINE DESIGN, *$6.75 postpaid.*

This new edition presents a discussion of the basic concepts underlying electric circuits, electrical machines and electronics, and points the way to the solution of practical problems. Because voltages and currents are more often variable than steady, the book emphasizes the alternating-current circuit, particularly single phase. New sections deal with the transistor, crystal diodes and the resistance strain gage; these added sections bring the text up to date technically. Other sections, including the chapter on synchronous machines, have been rewritten to provide a clear and simpler analysis. A new appendix on the magnetic circuit provides a basic introduction to field theory.

Association Publications

Structural Chemistry and Metallurgy of Copper. *By D. K. Crampton, director of research and development, Chase Brass and Copper Co.; 28 pages, 6 by 9 in., paperbound; published by and available from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.; $1.50 per copy.*

This book discusses some of the new work on recrystallization and grain growth of copper alloys, investigating time intervals much shorter than previously used. It also discusses the structural chemistry of copper and copper alloys, particularly in relaxation of grains and grain boundaries both in pure copper and in some copper alloys;

5-A-85

new investigations of the fundamentals of corrosion and corrosion resistance of copper, and some of the factors affecting incidence of corrosion pits.

ASTM Standards on Zinc-Coated Iron and Steel Products. 136 *pages, 6 by 9 in., paperbound; published by and available from American Society for Testing Materials,* 1916 *Race St., Philadelphia* 3, *Pa., $2.25 per copy.*

This publication is intended to present in convenient form for reference the various ASTM standards, tentative methods for test, and specifications pertaining to metallic-coated iron and steel products. Included in the volume are 21 specifications, of which four are new or recently revised; three recommended practices, of which two are new; and five methods of tests. Among the materials covered are wire, strands, sheets, hardware, terne-alloy coated sheets and miscellaneous products.

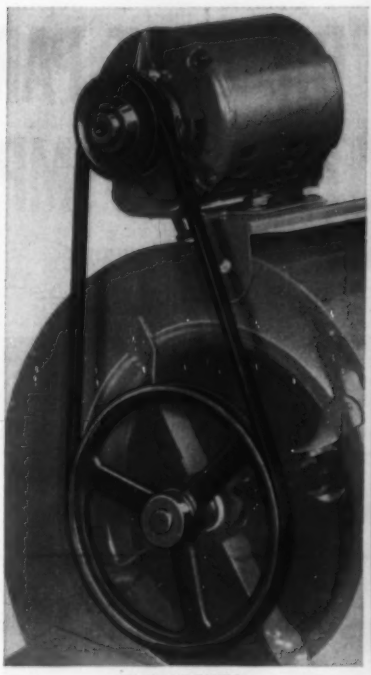
Lead in the Ceramic Industries. 140 *pages, 8½ by 11 in., loose-leaf binder; published by and available on letterhead request from Lead Industries Association,* 60 *East 42nd St., New York* 17, *N. Y.*

This book describes the lead products used in ceramics and gives their properties, including the most important phase diagrams involving lead compounds. It explains the properties imparted by these compounds to the various forms of ceramics. Detailed sections describe the use of lead compounds in glazes, glass, porcelain enamels for iron, steel and aluminum, glass decorating colors, ceramic bodies such as low dielectric, piezoelectric and others, and miscellaneous applications.

Manufacturers' Publications

Magnetrons and Traveling-Wave Tubes. 40 *pages, 8½ by 11 in., paperbound; published by and available from Radio Corporation of America, Tube Division, Harrison, N. J.; 50¢ per copy.*

This book contains basic information on the features and applications of microwave devices. The booklet describes the theory of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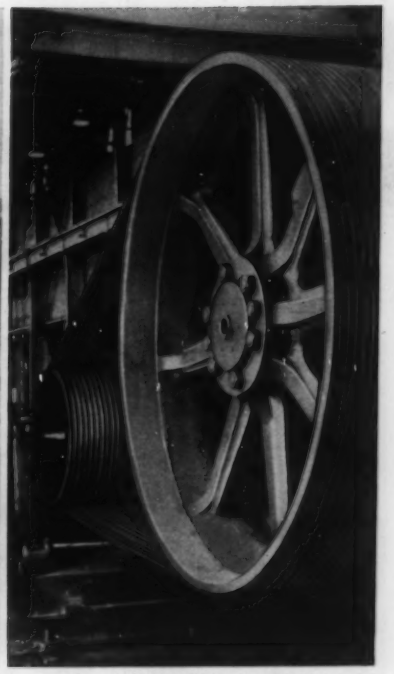
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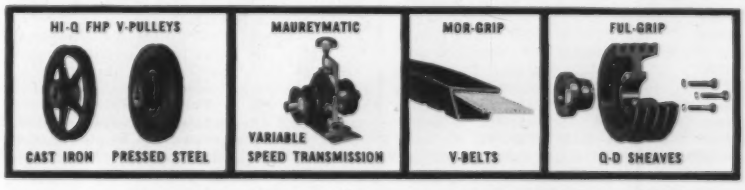

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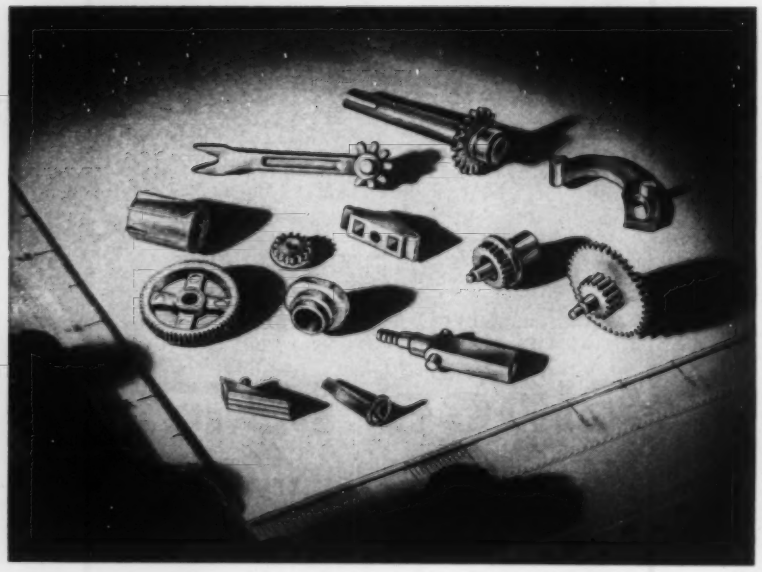

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Gries produces by their exclusive die casting technique a line of high quality, low cost threaded fasteners, including wing nuts, cap nuts, wing screws, round-head thumb nuts, round-head thumb screws, rivets, which are available in a wide range of sizes. Quick delivery from stock. Specials to order. All are non-ferrous, rustproof, with clean threads and bright finish. GRC mass production techniques provide lower costs. A new bulletin is now available. Write for your copy of Gries Industrial Fastener Bulletin.

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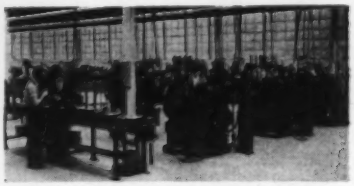

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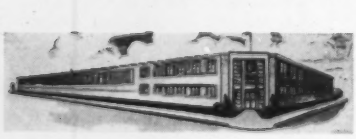

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operation of magnetrons and traveling-wave tubes, presents operating considerations and applications, and gives techniques for measurement of important electrical parameters. Shown are the structural parts of both types of tubes, typical performance characteristics, test methods, and representative circuit applications. Data are given for four commercially available magnetrons and one traveling-wave tube.

Stainless Castings. *28 pages, 8½ by 11 in., paperbound; published by and available on letterhead request from Allegheny Ludlum Steel Corp., Advertising Dept., 2020 Oliver Bldg., Pittsburgh 22, Pa.*

This booklet gives detailed information on corrosion and heat-resisting stainless-steel castings. There is a special technical-data section in the booklet which gives detailed information on physical properties and chemical-composition standard analysis on stainless steels used in casting. The book also lists applications for the castings and shows how they are produced.

Government Publications

Study of Coiled Tubing for Aircraft Hydraulic Systems, PB 121477. *By Conrad Cooke and Ronald Stouffer, of The Glenn L. Martin Co.; 115 pages, 8 by 10½ in., paperbound; available from Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.; $3.00 per copy.*

Recommended design criteria for coiled stainless-steel tubing in aircraft hydraulic systems are contained in this report. Flexible tubing is of interest to aircraft and piping industries because of high operating temperature (up to 700 F) and relative light weight. Sections can be fabricated from plain hydraulic tubing and standard hydraulic fittings can be used.

The recommended limitations in the report were based on analysis of elements for stresses and deflections caused by mechanical flexure and internal pressure. Fatigue data were gained from a survey of industrial applications. Both straight and curved configurations were analyzed.

5th of a Series

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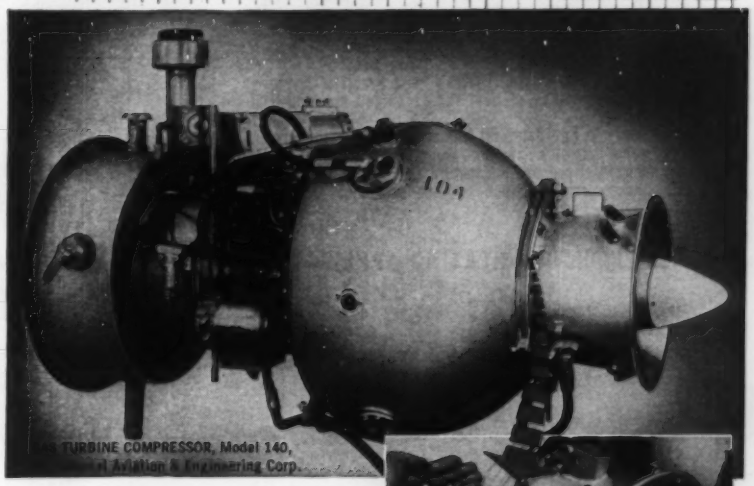

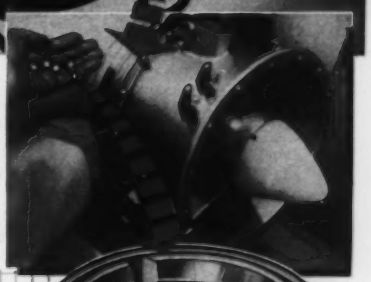

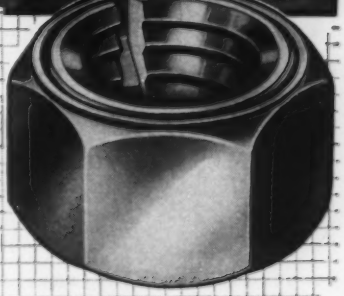

problem: The Continental Gas Turbine Compressor illustrated here is a dependable and efficient power supply for military ground support trailers. This compact unit weighs only 210 lbs. and delivers 205 air h.p. at 35,000 r.p.m. The tail pipe cone is subjected to severe vibration and extremely high temperature in excess of 1200° F. Continental Engineers required a self-locking nut which could withstand these high temperatures and maintain a secure lock under extreme vibration.

solution: A standard Dura-Loc 1600 High Temp Nut successfully meets the critical requirements of this unusual application. The Dura-Loc 1600 Nut withstands the extremely high temperatures involved, and provides a completely safe fastening under severe vibration. The unique, patented collet action of the Dura-Loc 1600 Nut assures easy installation and simple, quick removal with high re-usability. Let the safety and labor-saving features of the Dura-Loc 1600 help solve your *jet-hot* fastening problems!

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☐ Fasteners to 1600°F. operation
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Circle 615 on page 19

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TYPICAL INDUCTION HEATING APPLICATIONS

HARDENING DIESEL FUEL INJECTOR

Restriction of heat to end of holder body for fuel injector permits hardening of face to provide required resistance to deformation without hardening the threads. Coil design shown provides uniform temperature for hardening despite holes in face.

REMOVING RUBBER FROM STEEL

Induction heating develops uniform temperature at steel-rubber interface destroying bond for easy separation. Steel and rubber may similarly be salvaged from mounting brackets, shock absorbers, etc.

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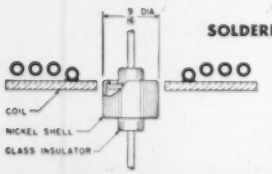

Concentrator-type coil creates high intensity, restricted heating at joint of nickel shell and tinned glass, thus causing solder flow for permanent seal

Electronic Tube Generators from 1 kw to 100 kw. Spark Gap Converters from 2 kw to 30 kw.

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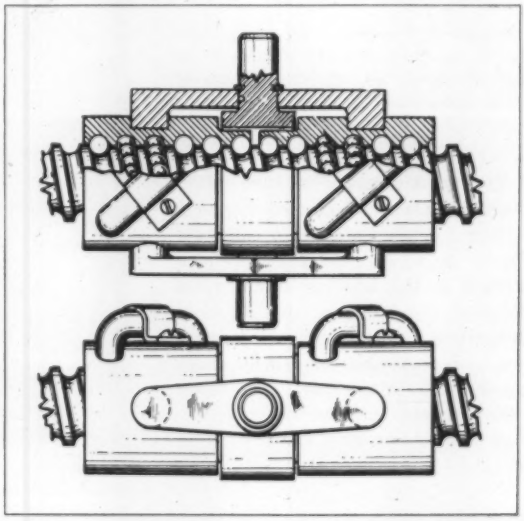
NOTEWORTHY

Patents

Antifriction Nut Assembly

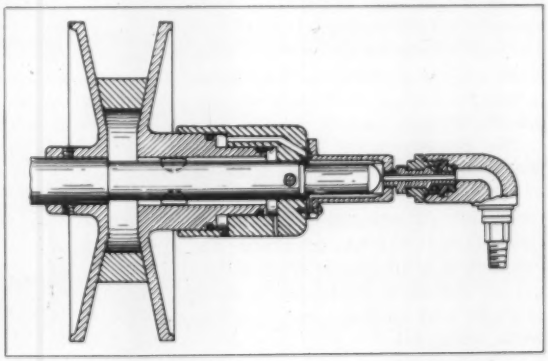
Short antifriction nuts (1½ to 2½ turns), coupled by a load-compensating yoke, provide high load-carrying capacity in an antifriction nut assembly. Compared to a single nut of equal capacity, the multiple-



nut arrangement reduces possible interference and friction between adjacent balls. Error in the lead of the screw is also compensated by the assembly, since the yoke permits limited rotation between the two nuts, dividing the load equally despite lead errors. *Patent 2,779,207 assigned to Cleveland Pneumatic Tool Co. by Wallace Hamilton.*

Adjustable-Pitch Pulley

Pitch-changing force in a fluid-operated adjustable-pitch pulley is provided by an integrally mounted hydraulic cylinder. Transfer of pressurized fluid to the cylinder (which rotates with the pulley) is through



Q

Saving all you can on

Production Bronze Castings?

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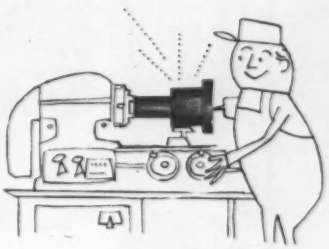

A

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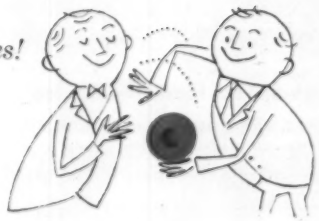
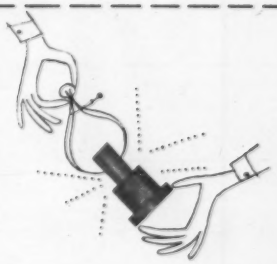
Smoother cast surfaces!

Often, smooth enough to use as is



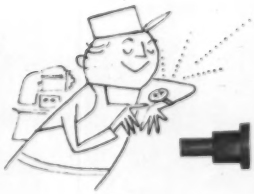
Closer tolerances!

Most castings held to ±.015 — favorable shapes, ±.010.



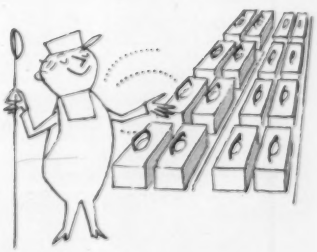
Less machining!

In some cases, finishing operations are eliminated.



Lower cost!

High-speed, semi-automatic mold production means foundry economy.



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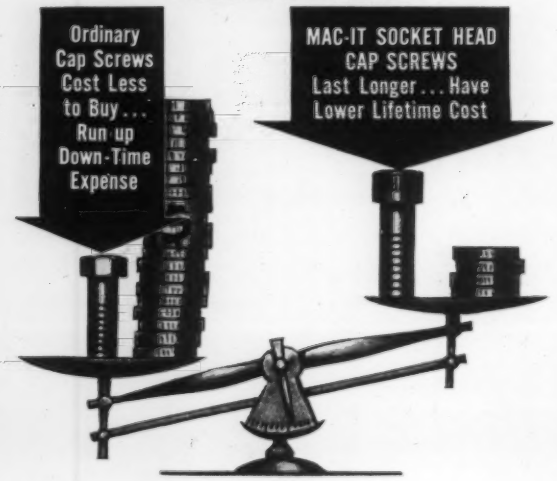
D-61

THE HIGH COST OF CAP SCREW FAILURES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If a screw fails on a production machine, it could . . .

. . . Cause	. . . Resulting in
an idle or damaged machine	lost production and possible hold-ups along the assembly line
an idle machine operator	higher non-productive overhead costs
possible injuries to workmen	medical and workmen's compensation expenses
irreparable damage to costly dies	high replacement costs
extra work for maintenance crew	more non-productive overhead costs

If a screw fails on an assembled product, it could . . .

. . . Cause	. . . Resulting in
extra work for field service crew	high labor costs
customer dissatisfaction	loss of sales

Add it up! It's not worth trying to save a few cents by buying ordinary cap screws. You should standardize on Mac-it Socket Head Cap Screws because their high quality, precision and long service life mean fewer failures, lower maintenance and down-time costs.

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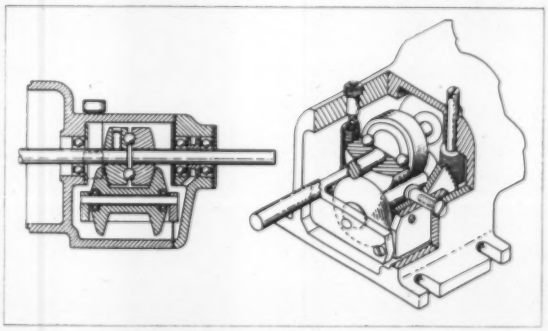
MAC-IT hex socket alloy cap & set **SCREWS**

Noteworthy Patents

an axially mounted rotary joint. In a typical installation, such as a V-belt power transmission, pulleys are used in pairs, with change in speed ratio being accomplished by changing the fluid pressure routed to the individual pulleys. *Patent 2,779,203 assigned to Morrison Supply Co. by Glenn M. Eubanks.*

Adjustable-Speed Drive

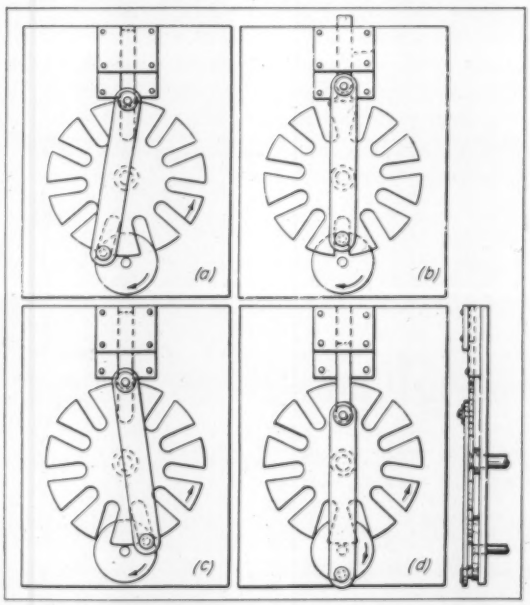
Continuous change in speed ratio over a wide range is provided by a traction-type adjustable-speed drive for fractional-power service. Principal components



are a pair of contoured driving and driven disks mounted on the ends of input and output shafts and frictionally coupled by a spool-shaped intermediate element. Change in speed ratio is accomplished by tilting the coupling spool so as to engage the driving and driven disks at different radii. *Patent 2,784,604 assigned to Excelermatic Inc. by Charles E. Kraus.*

High-Speed Indexing Device

For handling heavy loads with speed and accuracy, an intermittent-motion device is locked positively against rotation between drive periods. Shown here



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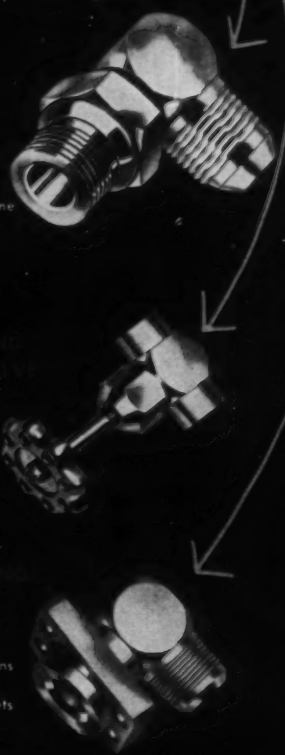

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Circle 621 on page 19

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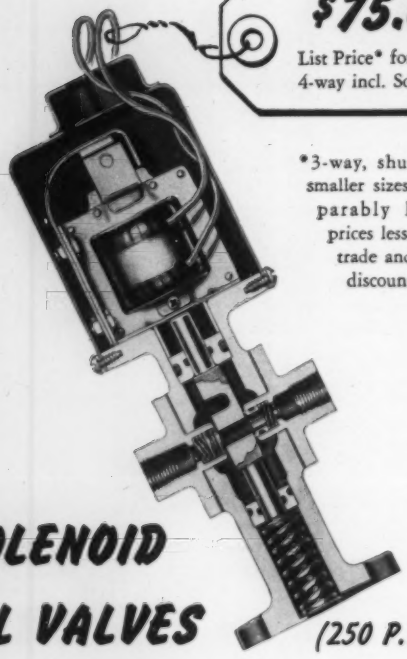

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WHERE	WHY	HOW
Thread rolling machines	Holding position (leakproof)	Lapped sealing surfaces seal tight indefinitely as a result of wear compensation
Pressure testing in automotive production	Oil gets contaminated by scale in castings (not critical to dirt) reduced maintenance	Sealing surfaces in constant, intimate contact, dirt can't lock valving members – saves coil burn-out
Hydraulic work feed apparatus	(Leakproof) ... as versus spool valves which cause over-demand on hydraulic system	Positive shut off of internal port to port leakage and of course, no external leakage
Machine tool chucking & clamping	Maintaining safe holding pressure (leakproof)	Saving auxiliary equipment such as pilot operated check valves
Automatic door openers	Quick action (high flow capacity)	No spools or poppets obstructing full, round flow passages
Solenoid controlled hydraulic system on machine you build	Better performance	Shear-Seal valves have full flow, are leakproof, not sensitive to dirt
	Lower manufacturing costs	Low priced, less auxiliary equipment and labor cost.
	Reduce service problems	Valves don't stick, saving coil burn-out; stay leakproof indefinitely, seals are wear compensating

BARKSDALE VALVES

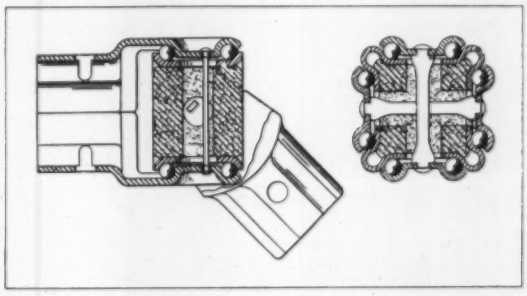
5125 Alcoa Avenue, Los Angeles 58, California
Ask for bulletin 5S-H

Noteworthy Patents

in successive positions (*a* through *d*), the mechanism comprises a continuously rotating drive wheel and pin, a radially slotted driven wheel and a locking bar. In operation, the drive pin enters radial slots in the driven wheel, imparting intermittent rotation. During dwell periods, the reciprocating slide, mounted opposite the drive wheel and pin, enters a radial slot in the driven wheel, effectively blocking further rotation. *Patent* 2,784,599 *assigned to Magnavox Co. by Norbert Leo Moulin.*

Ball-Bearing Universal Joint

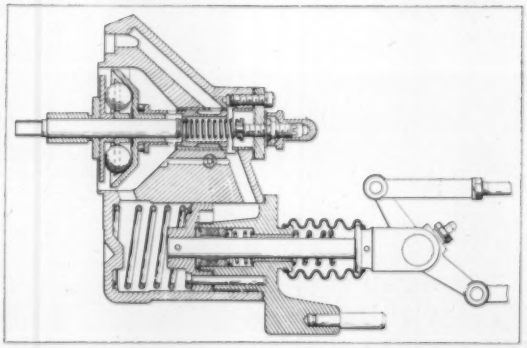
All body and yoke parts are simple stampings in a Hook-type universal joint with high-performance capabilities. For transmitting light or heavy loads,

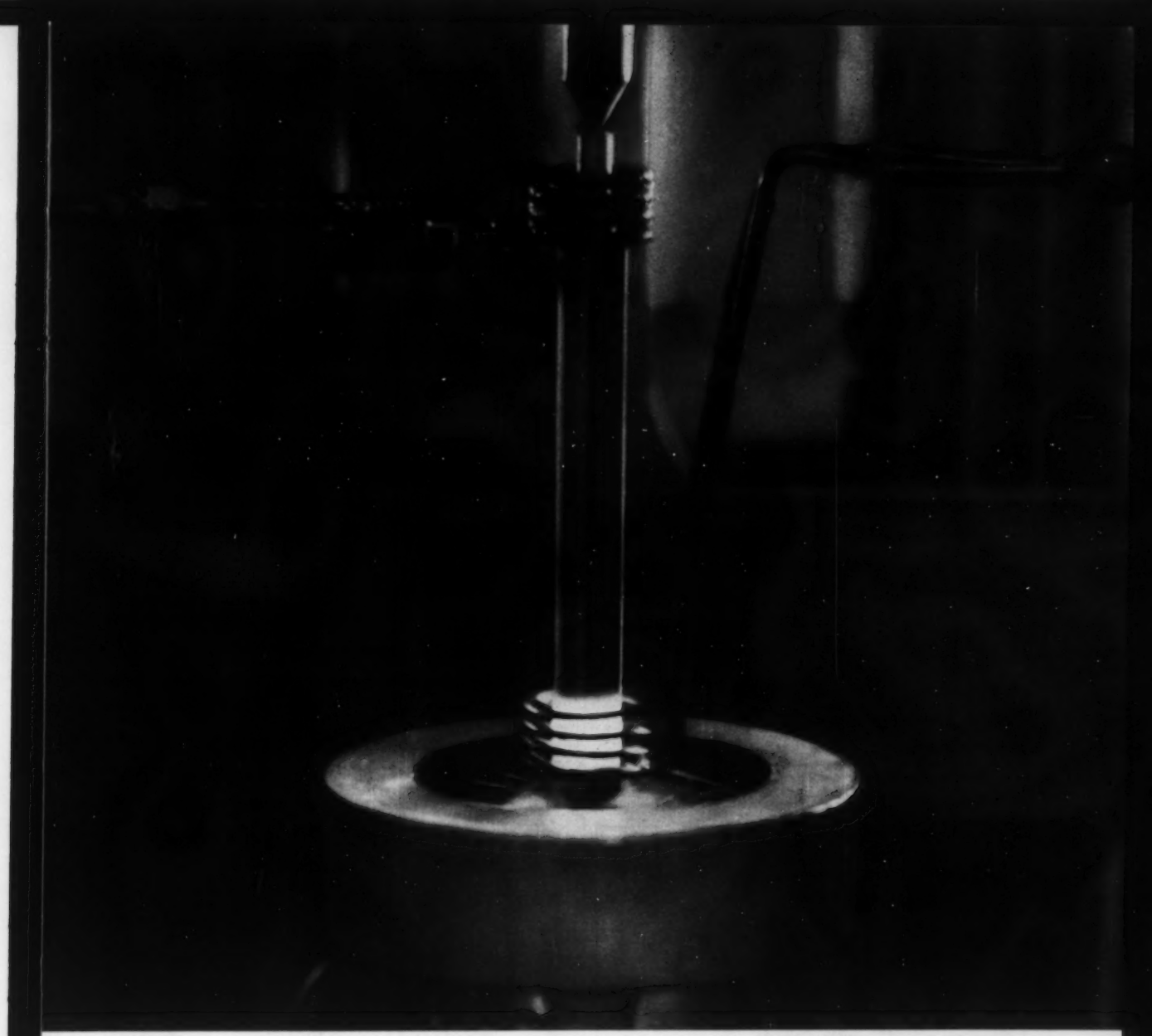


even at extreme shaft angles, the unit supports all motions on ball bearings, eliminating rubbing friction entirely. Lubricant supply for the joint is retained by a felt pad arrangement which also cleans the special needle-pointed lubricant gun as it is inserted into the center of the unit. An adjustment or takeup is provided to compensate for any wear in the joint that may occur in service. *Patent* 2,783,626 *assigned to Process Gear and Machine Co. by Alfred W. Klomp.*

Hydraulic-Boost Governor

High control forces developed by a centrifugal governor with hydraulic boost provide fast throttle action and positive engine control with minimum speed overshoot. Unit combines a centrifugally actuated fly-ball and valve section (top) with a hydraulic piston assembly (bottom). When set-point speed is exceeded, a substantial flow of hydraulic fluid is introduced into the cylinder, rapidly retracting the





Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor — Railway & Power Engineering Corp., Ltd.

Circle 623 on page 19

BOARDMASTER BY UNIVERSAL

The volume of engineering design requires the selection of properly engineered drafting machines. Universal's Boardmaster offers ten major advantages, including Ball Bearing Indexing, Unlimited Protractor Visibility and Positive Baseline Control. We invite you to study this information. You may well discover that the long-time economy of Boardmaster drafting machines justifies the replacement of less efficient equipment. Write for folder, "More For Your Money".

UNIVERSAL DRAFTING MACHINE CORPORATION
7960 LORAIN AVENUE, CLEVELAND 2, OHIO

Circle 624 on page 19

TRU-O-SEAL
TEFLON SEAL

STOPS PIPE THREAD LEAKS

PAT. PENDING

Satisfaction Guaranteed Or Money Back TRIAL OFFER

TRU-O-SEAL Fittings are guaranteed to seal pipe thread connections permanently against all oils, practically all known chemicals and gases; to seal under high pressures or vacuum; to withstand —280° to plus 500° F.; to eliminate "overtightening" damage and pipe dope. Available in ⅛" to 2½" pipe thread sizes.

$10.00 Trial Offer No. 1: eight ⅛", ten ¼", eight ⅜", ten ½" pipe thread TRU-O-SEAL Fittings.

$10.00 Trial Offer No. 2: eight ½", ten ¾", four 1" pipe thread TRU-O-SEAL Fittings.

Send order to

TRU-O-SEAL DIVISION
Flick-Reedy Corporation
2006 N. Hawthorne Melrose Park, Ill.

"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.

1 Thread TRU-O-SEAL on pipe or fitting (no messy pipe "dope" needed). SEAL SIDE

2 Thread pipe or fitting 4 threads into port. Point in desired direction.

3 Tighten TRU-O-SEAL to complete leakproof assembly (only light torque required).

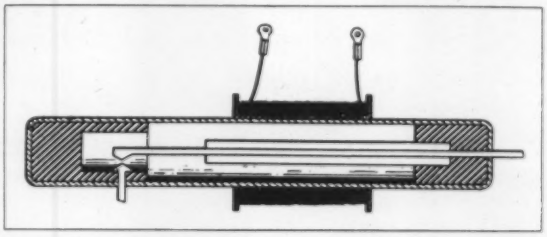
Circle 625 on page 19

Noteworthy Patents

piston rod and closing the engine throttle. Piston return stroke is by spring action. *Patent* 2,745,384 *assigned to Novi Equipment Co. by Herman G. Adler.*

Magnetostrictive Relay

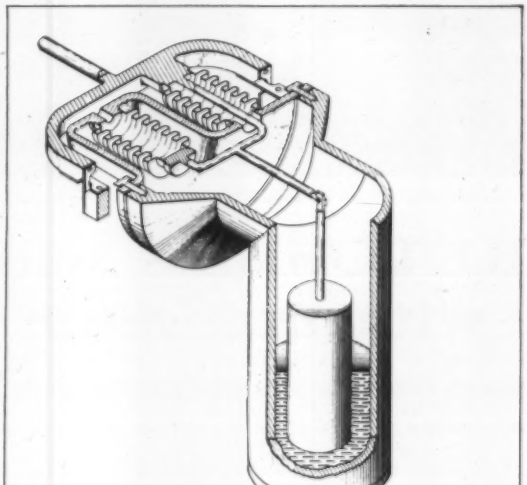
Ferromagnetic strips that form the active element in a magnetostrictive relay are cut from a single ferromagnetic crystal. This prevents inadvertent con-



tact operation that might be caused by thermal differential expansion or contraction. Required positive and negative magnetostrictive coefficients for the two parts of the active element are obtained when the single crystal is suitably oriented before cutting. *Patent* 2,782,280 *assigned to International Business Machines Corp. by Lawrence R. Bickford Jr.*

Pressure-Compensated Seal

For use in pressurized instruments and similar devices, a bellows-type pressure-compensated seal transmits pivoting linkage motion through a housing with negligible torque. To eliminate effects of fluid pres-



sure on the inside surface of the sealing bellows, a compensating bellows is provided with the same pressure applied to its outside surface. Net effect of the action of the two bellows is to cancel out forces and motions that might result from housing pressure changes. *Patent* 2,779,197 *assigned to Minneapolis-Honeywell Regulator Co. by John M. Embree.*

STACKED

INDUSTRIAL RETAINING RINGS

Cut Costs... Speed Assembly

- Provide inexpensive shoulders on shafts
- Reduce product weight and bulk
- Packed in stacks for fast and easy "one-at-a-time" dispensing and application
- May be removed and reapplied on the job without special tools

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Patented

INDUSTRIAL RETAINING RING CO.

57 Cordier Street, Irvington 11, New Jersey

Originators of modern retaining ring dispensing

Circle 626 on page 19

BRISTOL socket screws help Army NIKE blast off

We're proud that Bristol Multiple-Spline socket screws were selected for use in the NIKE, *first truly operational U. S. guided missile.*

First, because NIKE and its complex guidance equipment are so important to our national defense.

Second, because we know that these Bristol Multiple-Spline socket screws met the most exacting requirements for holding power against shock and vibration. The Bristol-originated Multiple-Spline socket allows these screws to be wrenched up exceptionally tight without danger of stripping the socket.

Bristol Multiple-Spline socket screws, both set and cap, are ideal for critical applications in a host of products, in addition to missiles and guidance equipment: communications equipment of all types, shavers, instruments, vending machines, cameras, desk calculators—wherever ability to take extra wrenching torque is a factor.

Find out about them from your industrial distributor today.

A.6.36

Precision socket screw manufacturers since 1913

*Made in sizes as small as No. 0 in Alloy Steel and Stainless Steel. Cap Screws up to 1½".

THE BRISTOL COMPANY, Socket Screw Division, Waterbury 20, Conn.

Circle 627 on page 19

If your VACUUM or PRESSURE requirements are in this range

Vacuums to 27" Hg.
Pressures to 20 psig.
Displacement:
3.6 to 7.2 c.f.m.

. . . save space - - simplify mounting - - eliminate troubles - - improve operation

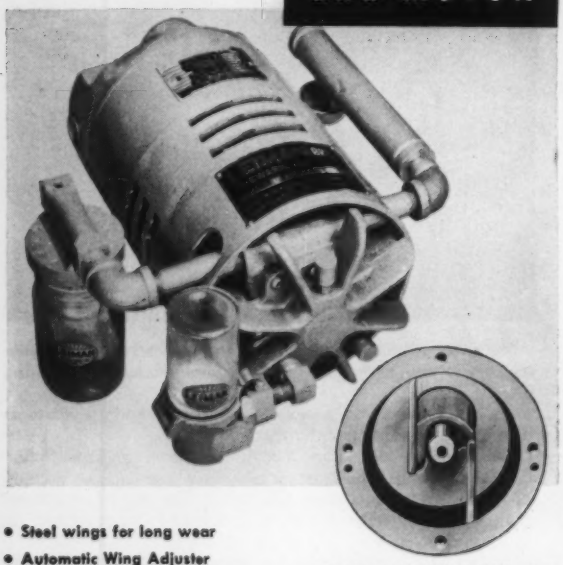
with

LEIMAN

Integral Rotary AIR PUMP and MOTOR

MODEL K. 3.6 c.f.m. ⅓ hp. 13½" long - - 12" wide - - 7" high

MODEL K3. 7.2 c.f.m. ½ hp. 16" long - - 15" wide - - 9" high



- Steel wings for long wear
- Automatic Wing Adjuster
- Automatic oiler—requires filling only once in 60 to 80 hours.
- Ball bearings for quiet running
- Bearing grease cups need checking only once in 90 days
- Fan cooled—may be run 24 hours a day, 7 days a week
- Automatic thermal overload motor protection
- Noiseless operation
- Inlet filter and outlet separator
- Oil-free air

Automatic Wing Adjuster
Patented Leiman feature adjusts automatically, pushes steel wings into contact with cylinder wall, assures constant seal, prevents wings from sticking or binding.

•

Write for detailed folder and 12-page catalog showing many other Leiman pumps.

LEIMAN BROS, Inc.

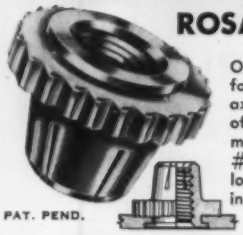
148 Christie Street, Newark 5, New Jersey

Circle 628 on page 19

SIMPLIFY DESIGN

WITH THESE 2 GREAT NEW FASTENERS

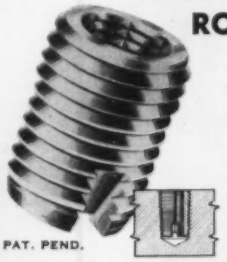
ROSÁN PRESS - NUT



PAT. PEND.

Only one size Rosán Press-Nut is needed for any thickness of material. Locks both axially and radially. Develops full strength of mating bolt. Flush mounting in sheet metal as light as .035 thick. Thread sizes #2 through #10. Stainless Steel or Ledloy with or without internal thread locking. Extremely simple to install.

ROSÁN INSERTO



PAT. PEND.

A radically new, internal "hex"-driven locked-in steel insert. Perfectly suited for use in Aluminum and Magnesium alloys. Self-tapping, standard threads, easy to install and remove. Resists both high torque and tension loads. It costs less to drive an Inserto than to tap a hole. Let us prove it to you.

These and many other threaded fasteners now available for your use.

SEE US AT THE DESIGN ENGINEERING SHOW MAY 20th, BOOTH 806

ROSÁN INC.

2901 WEST COAST HIGHWAY
NEWPORT BEACH, CALIFORNIA

Circle 629 on page 19

Here's the Answer to Accurate Timing of Electrically Operated Equipment

ZENITH INTERVAL TIMER

Especially recommended for operation of blowers, pumps, agitators, mixers, conveyors and other machinery . . . widely used for plastic moulding, rubber curing, heat treating, enamel baking, light exposure and similar operations.

Fully enclosed. Double-throw, single-pole switch. Self-starting slow speed industrial type synchronous motor. Time range: 60 seconds to 72 hours.

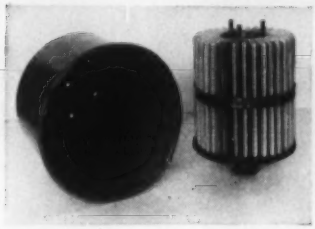
Send for full information, including bulletin on Zenith's complete line of automatic control equipment.

ZENITH ELECTRIC CO.

149 WEST WALTON STREET • CHICAGO 10, ILLINOIS

Circle 630 on page 19

NEW DRY TYPE AIR FILTERS
for engines, compressors, blowers and other industrial applications



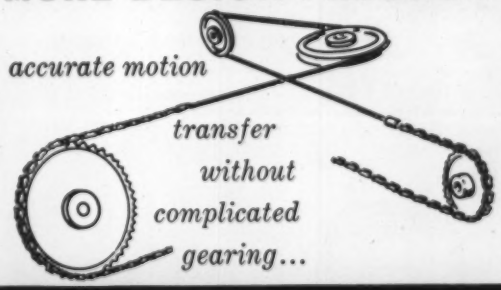
• Designed for specific applications, the new Air-Maze Dry Type filter is particularly suitable where 1.) oil free air is required, 2.) an extremely high degree of filtration is required, 3.) the air velocity varies from one period to another and, 4.) the dirt concentration is relatively low, except when vibration is present to help dirt removal.

The Air-Maze Dry Filter is one of the most efficient mechanical type filters available. Laboratory tests indicate better than 98% efficiency with particles of 2 micron mean diameter and practically 100% efficiency with particles of 5 microns or larger.

The Air-Maze Dry Filter type DA employs a special highgrade felt filtering media arranged in deep pleats to provide extended area, and armored on both sides by heavy galvanized cloth. Heavy gauge perforated tubing inside the media and a metal strap on the outside form a rigid unit of great strength and are corrosion protected. Made in sizes from 20 cfm to 6650 cfm. Catalog DA-1056 available. Write **AIR-MAZE CORPORATION**, Cleveland 28, Ohio.

Circle 631 on page 19

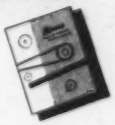
MORE DESIGN FREEDOM



SIERRA MINIATURE MECHANICAL CHAIN AND SPROCKETS...

Provide precise, positive motion transfer through several planes simultaneously with no cable slippage...no complicated gearing. Unlimited center-to-center selection for miniature and sub-miniature assemblies in servo systems, gyro systems, special cameras, electronic equipment, and small precision instruments. Less weight, cost, maintenance —wider tolerances. Designed to operate around minimum 7-tooth sprocket with root diameter of .250 inches. Chain pitch .1475 inches; Weight .45 oz. per lineal ft. Material: stainless steel, or other materials, including non-magnetic beryllium copper.

NEW CATALOG



Contains useful application data, specifications, tables on chain pitch and sprocket sizes, suggestions for calculating center-to-center distance. *Write for yours today.*

123 E. Montecito Avenue, Sierra Madre, California

Sierra ENGINEERING CO.

T. M. REG.

Circle 632 on page 19

1 Vari-Typer saves the lettering time of 4 draftsmen!

Why waste your high-priced draftsmen on simple lettering jobs when your office typist, using the Vari-Typer, can do these jobs 4 times faster.

Vari-Typer Model E-24 with hundreds of instantly changeable type faces, is especially designed to give clean, crisp lettering on tracings (cloth or paper) even 12 feet or more wide!

Here is a simply operated, cost-saving lettering machine ideal for lettering on specification sheets, bills of material, instruction manuals, and forms. Type fonts are available with engineering and mathematical symbols.

Vari-Typer is currently saving thousands of draftsman hours in many of the world's leading industrial and engineering organizations. Ask your nearby Vari-Typer man for a free demonstration or write direct for information.

Text of this advertisement was composed on a Vari-Typer. (Headlines by Headliner).

Vari-Typer

VARI-TYPER CORPORATION

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SUBSIDIARY OF ADDRESSOGRAPH-MULTIGRAPH CORPORATION

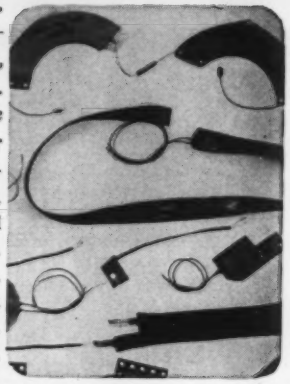
Circle 633 on page 19

SPECIALISTS IN—

HEATING ELEMENTS

ANY SHAPE . . .

also *Any Size*—large, small or very thin—*Light Weight, Tough, Flexible,* as required. Completely *High Voltage Tested.* Operate under *High Pneumatic Pressure. Resist corrosion. Immersable.* Insulated with Silicone Rubber, Neoprene, Kel-F Resin, Polyethylene, etc. Meet *USAF Specs. Low Cost.* Standard units available.



Write or call—

Electro-Flex Heat, INC.

83 WOODBINE ST., HARTFORD 6, CONN. (CHapel 7-2401)

send for free illustrated booklet

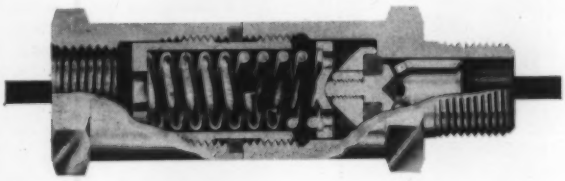
"FIRST with STANDARD ELEMENTS"

Circle 634 on page 19

This

RELIEF VALVE

Seals Tight



Seals Tight To over 95% of cracking pressure provided by Circle Seal's "O" Ring sealing principle.

Relieves Accurately Opens consistently at preset cracking pressure.

Flows Freely Minimum flow restriction due to streamlined poppet and full flow ports.

Reseats Tight Zero leakage within 10% of cracking pressure.

Circle Seal Representatives throughout the United States

Circle Seal Products Co.
Incorporated
2181 EAST FOOTHILL BOULEVARD
PASADENA, CALIFORNIA

Circle 635 on page 19

"Hey! I hear NORDBERG has

"Yes, sir. They use aluminum bearings in their big gas-burning radial engines and haven't had a failure. Guess it's because only aluminum can handle 10,000 psi on projected area."

"More likely, it's because aluminum runs 20° cooler than ordinary bearings. You know, less burnouts and seizures."

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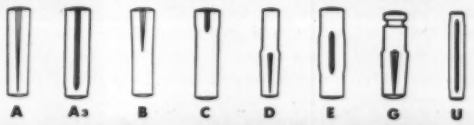
complete details on grooved pins and studs

Your copy of the new DRIV-LOK grooved fastener catalog is ready now. Write for it today. 24 pages of factual data in concise, easy to use form. No obligation, of course.

STANDARD TYPES . . . A COMPLETE LINE



DRIV-LOK PIN COMPANY
715 Chauncey St. • Sycamore, Illinois

Circle 636 on page 19

IT'S A SNAP!

TO MAKE AND INSTALL V-BELTS IN MINUTES WITH BRAMMER

You can measure, couple, and install Brammer "V" Link Belting in minutes without dismantling, fuss, or special skill. Slashes down-time. Adjusts simply.

NEW IMPROVED BRAMMER BELTS GIVE YOU THESE NEW ADVANTAGES

NEW PRE-STRETCHING — NEW BRAMMER TOOL
NEW SIZE-IDENTIFICATION — NEW IMPROVED COMPOUND
NEW PERMALIFE RIVET — NEW GREEN FOR NEOPRENE

VISIT OUR BOOTH 1038 AT MACHINE DESIGN SHOW

BRAMMER CORPORATION
684 Broadway
New York, N.Y.

Circle 637 on page 19

racked up over 40,000 hours on these Alcoa® Bearings!"

"I hear aluminum bearings roll the dirt particles right out. They embed better than bronze, but not as deeply as babbitt. Oil additives won't corrode them either."

"Do you know that solid aluminum bearings have no hard backing? They can't damage shafts if they fail. They also eliminate the bond fatigue problem since they're monometallic."

"The word is getting around that solid aluminum bearings, cast by Alcoa and machined by leading bearing manufacturers and users, are just about perfect. More information? Write Aluminum Company of America, 1986-E Alcoa Bldg., Pittsburgh 19, Pa."

ELCO SCREWS ARE GOOD SCREWS
Ask a man who has used them

COLD-HEADED SPECIALS REDUCE COSTS...

ELCO Cold-Heading is the logical and low-cost method of manufacturing pieces such as are shown above. Complex machining operations are avoided, accuracy is maintained, uniformity insured, and production speeded up. Our experienced engineers are available to assist in design or re-design of your pieces to take advantage of ELCO Cold-Heading. *Send us your prints!*

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- TAPPING SCREWS
- THREAD-CUTTING SCREWS
- PHILLIPS AND SEMS SCREWS
- PIPE PLUGS
- STOVE BOLTS
- CAP SCREWS
- LAG SCREWS
- DRIVE SCREWS
- SPECIAL SCREWS
- COLD HEADED PRODUCTS

WE ALSO SPECIALIZE IN MAKING ANY OF OUR PRODUCTS OF THE FOLLOWING MATERIALS

Stainless Steel	Copper	Monel
Bronze	Silicon Bronze	Aluminum
Brass	Ambrac	Special Analysis

ELCO TOOL AND SCREW CORPORATION
1950 BROADWAY • ROCKFORD, ILLINOIS

Circle 639 on page 19

THIS BOOKLET "FLOW INDICATING DEVICES" IS YOURS

... CONTAINS DATA ON WIDE SELECTION OF FLOW DEVICES SUCH AS:

Fig. 54A Flow Sight — Fig. 816 Teleflo Indicator — Fig. 811 Flow Indicator

Plant and product engineers have relied on Bowser, liquid handling specialists since 1885, for prompt service. For sight glasses in single or double-window types, gravity or pressure models; or for electric or mechanical indicators . . . there is a Bowser man nearby ready to help you . . . quick!

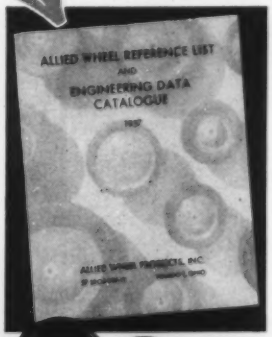
PRODUCT OF RESEARCH — BOWSER

WRITE FOR FLOW DEVICES BOOKLET } *Contains Complete Specifications*

BOWSER, INC., 1314 E. CREIGHTON, FT. WAYNE, IND.

Circle 640 on page 19

FREE UPON REQUEST—
COMPLETE NEW CATALOG
ENGINEERING DATA
And REFERENCE LIST On
WHEELS
TIRES—HUBS BEARINGS



Every design engineer and procurement official needs this comprehensive data book for easy reference and guidance. A "must" for all producers of items that roll on juvenile, light or heavy duty industrial wheels.

GET YOUR COPY NOW

To obtain your FREE copy, just write us on your letterhead. Supplementary data sheets will be sent you as they are released.

ALLIED

ALLIED WHEEL PRODUCTS, Inc.
Dept. MD • 27 BROADWAY • TOLEDO 4, OHIO

Circle 641 on page 19

HOW XEROGRAPHY
and offset duplicating
save $500,000 a year for the U. S. Army Signal Corps

Photo shows typical 24"x36" drawing. Subject is reduced onto offset paper master (right) by xerography to 11"x17" size for runoff of multiple copies on offset duplicator.

The Army Signal Supply Agency, Philadelphia, Pa., is saving more than $500,000 annually by the use of xerography and offset duplicating in reproducing engineering drawings for invitations for bids.

Approximately 200,000 invitations are mailed each year to some 15,000 suppliers. Each invitation contains documents setting forth contractual conditions, specifications, and drawings describing the item desired.

For the Army Signal Corps' dramatic mortar locator, the MPQ-10, for example, 65 suppliers were solicited, each receiving 1,973 drawings or a total of 128,245. The reproduction method formerly used would have required 250 manhours at a cost of $6,040. Using xerography and offset duplicating, job time was reduced to 107 hours and cost only $2,180.

Let us show you with facts and figures how xerography is cutting duplicating costs in business, industry, and government for all types of paperwork duplicating.

Anything written, printed, typed or drawn can be quickly copied by xerography onto masters for duplicating. Copies in the same, enlarged, or reduced size can be made from one or both sides of the original material, by this dry, photo-exact, electrostatic copying process. New developments make xerography the one, all-purpose, fast and economical process for copying onto different types of masters for duplicating.

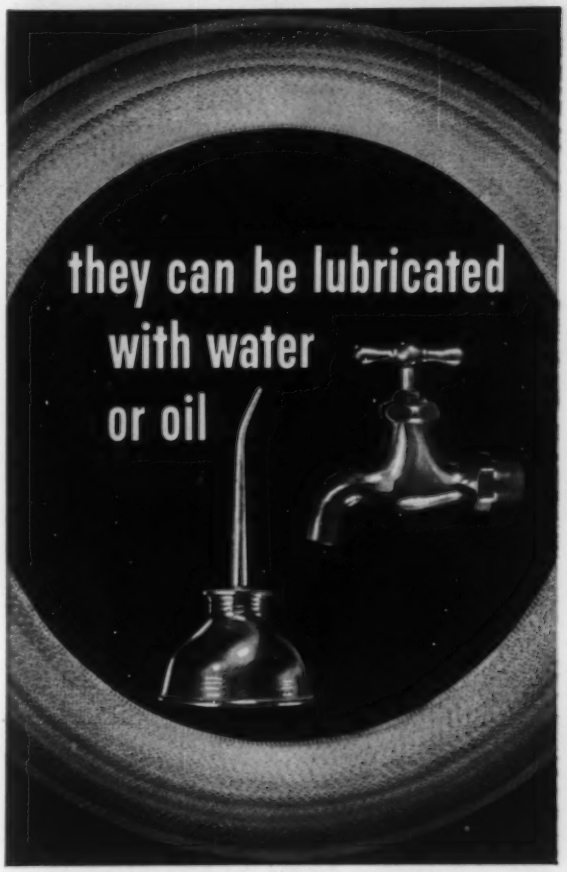
WRITE for "proof-of-performance" folders showing how xerography is saving time and thousands of dollars for companies of all types, large and small.

THE HALOID COMPANY
57-68X Haloid Street, Rochester 3, N. Y.
BRANCH OFFICES IN PRINCIPAL U. S. CITIES AND IN TORONTO

HALOID XEROX®

Circle 642 on page 19

Another thing about A·B·K bearings



A·B·K — the bearing material of 1001 uses

No lubrication problems here. This bearing simplifies design problems because water alone will lubricate it. So will grease or oil. Under certain conditions it can go *without* lubrication.

The unique properties of A-B-K Laminated Phenolic Bearings have helped engineers in widely divergent fields solve some of their toughest bearing problems.

A-B-K Bearing material simplifies lubrication problems. For certain uses it outlasts metal ten to one. It can be formed or machined to intricate shapes. It can be bonded to metal—has excellent resistance to abrasion.

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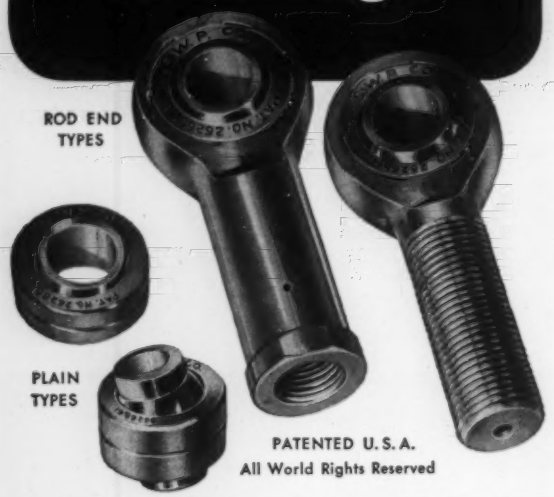
PROVED PROPERTIES

- Won't peen out
- High strength/weight ratio
- Resists acid, alkali, heat, abrasion
- High compression strength
- Perfect weathering
- Good machining
- Dimensional stability
- Outwears metal
- Water or oil lubricated

AMERICAN Brake Shoe COMPANY
American Brakeblok Division
DETROIT 9, MICHIGAN

Circle 643 on page 19

"MONOBALL" Self-Aligning Bearings



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1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
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Also manufacturers of Groov-Pins—for positive locking press fit.

GROOV-PIN CORPORATION
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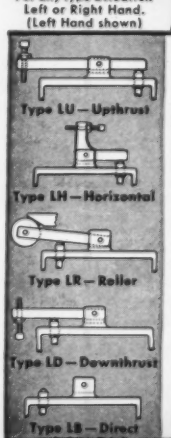
Circle 645 on page 19

Pneu-Trol TIME DELAY CONTROL SWITCH

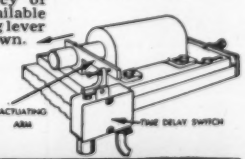
. . . Gives Cylinder Applications Greater Efficiency Accuracy . . . Wider Use!

For any type actuation Left or Right Hand. (Left Hand shown)



- **Holds Cylinder dwell accurately to fraction of second.**
- **Automatically re-sets.**
- **Simple, Compact, Rugged.**

You can hold any motion or operation controlled or actuated by air or hydraulic cylinders at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios with Pneu-Trol Time Delay Control Switches. Simple in design with positive hydraulic timing action . . . compact and easily mounted on the machine or fixture, Pneu-Trol Switches are providing millions of trouble-free actuations in solenoid-operated cylinder applications of every type. Positive, controlled time dwell permits wider use of air or hydraulic power in automatic operations, increases accuracy of work by insuring split-second accuracy of the dwell. Available with 5 actuating lever linkages as shown.



Switch mounted to provide dwell at end of power stroke of single action, spring return cylinder.

***Pneu-Trol* DEVICES, INC.**
1436 N. KEATING AVENUE • CHICAGO 51, ILL.

Circle 644 on page 19

Circle 646 on page 19

New
Engineering Handbook on

TEFLON*

Fully describes its advanced usage as a cushioning and insulating material for wire and tube supporting clamps.

Send now for your copy of this new 20-page illustrated "TX" Engineering Handbook on Teflon* (Tetrafluoroethylene). Contains all latest information on Teflon* including chemical, thermal, electrical and aging properties as well as modern methods of handling it. Illustrates seven models of Teflon* cushioned support clamps which are available in 18 standard types. Included is a comprehensive tabulated chart covering 28 tests, furnished courtesy of the Du Pont Company. Write today for free copy.

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Circle 647 on page 19

for AUTOMATED CONTROL, specify

Check the features of this new design:

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- Simplicity in design, trouble-free operation
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- 5 standard styles; full range of sizes — ⅞" to 3½" diameter

Check your requirements for electric clutch and brake control. You'll find SIMPLATROL Miniature and Small Electric Clutches and Brakes upgrade new machine performance, give faster, more precise sequence operations.

Ask for recommendations on Simplatrol units. New illustrated folder on request.

Simplatrol products corp.
24 SALISBURY ST., WORCESTER, MASS.
Representatives in Key Industrial Areas

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specify ATLANTIC METAL HOSE

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Available in steel, bronze, monel and various alloys of stainless steel with proper fittings.

Write for Bulletin No. 500A. See our Catalog in Sweet's Product Design File. Specialized engineering consultation available.

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Type SW Corrugated-Size 1"-20" I.D.

ATLANTIC METAL HOSE CO. INC
318 Dyckman St., New York 34, N. Y.

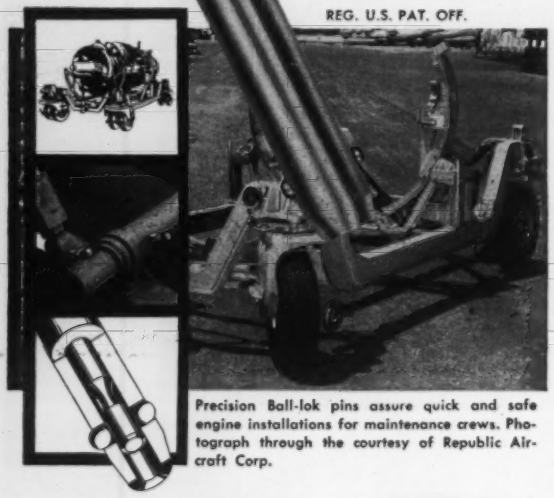
Circle 649 on page 19

Ball-lok® pins

quickly solve your locking problems

BL-ST
HANDLE TYPE

REG. U.S. PAT. OFF.



Precision Ball-lok pins assure quick and safe engine installations for maintenance crews. Photograph through the courtesy of Republic Aircraft Corp.

SAFETY • SIMPLICITY • STRENGTH

Whenever units are frequently assembled or disassembled the one operation Ball-lok pins assure you of *accident proof safety* . . . the operator must apply thumb pressure to the release button to pull pin. *Simplicity* . . . the one operation pins have less moving parts – completely eliminates all need of nuts, bolts, washers, clevis pins or other retaining items. Built in *strength* through simplicity of construction and the finest materials and workmanship. Ball-lok pins have met the most exacting requirements of aircraft manufacturers and military procurement. Available in most diameters and lengths of standard bolt sizes or manufactured to your specifications.

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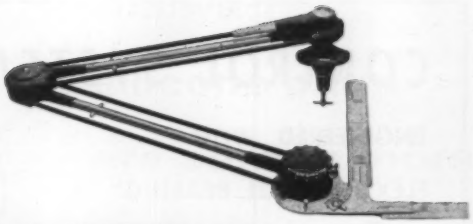
Circle 650 on page 19

Circle 651 on page 19



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drafting machines are designed for drafting better

VEMCO outperforms other drafting machines simply because VEMCO is designed to do the job better and faster. This is accomplished by such VEMCO features as automatic 15-degree settings, unusual flexibility, and easy floating motion on tilted boards. If you are dissatisfied with the performance of other drafting machines, now is the time to get acquainted with VEMCO.

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P.O. Box 950-M Pasadena, California

VEMCO

Circle 652 on page 19

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NO TOOL CHARGE!

Wide selection of stock knobs, handles and plastic parts available without tooling cost to you! Many minor changes (color, design, inserts, threads, special materials, etc.) can be made to meet your requirements.

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Circle 653 on page 19

OIL TIGHT DUST TIGHT OMNIDIRECTIONAL

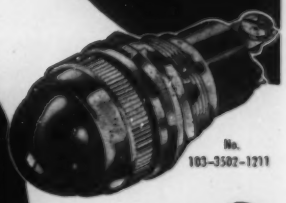
Exceptionally Rugged!

New

OIL TIGHT INDICATOR LIGHTS

for heavy duty use in industrial applications

Perfect oil-tightness is effected by retained oil-proof gaskets and the gasketed glass lens assembly . . . Install easily in a single 1" or 1-3/16" panel mounting hole. Also available for 11/16" mounting hole.



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A choice of *3 lens styles, 7 lens colors,* and other optional features provide adaptability.

DISCS with legends, behind flat lenses, deliver specific messages.

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OIL TIGHT INDICATOR LIGHTS

accommodate a wide range of Incandescent and Neon Glow Lamps. For neon, DIALCO offers an exclusive feature — *BUILT-IN RESISTORS* (U. S. Patent No. 2,421,321) for operation on 105-125 V, or 210-250 V. Simple external resistors are provided for all higher voltages. *EVERY ASSEMBLY IS AVAILABLE COMPLETE WITH LAMP.* For design purposes we will gladly send you:

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CATALOG "L-200" gives you complete specs on DIALCO'S Oil-Tight Indicator Lights. Also available—a file of Special Catalogs on DIALCO Pilot Lights covering every indication requirement for automation and miniaturization.

FREE— Brochure on "Selection and Application of Pilot Lights."

Foremost Manufacturer of Pilot Lights
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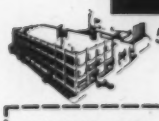

54 STEWART AVE., BROOKLYN 37, N. Y.
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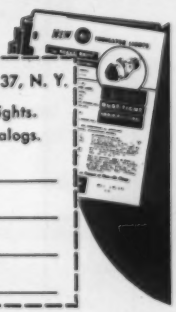

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☐ Please send Cat. "L-200" on Oil-Tight Lights.
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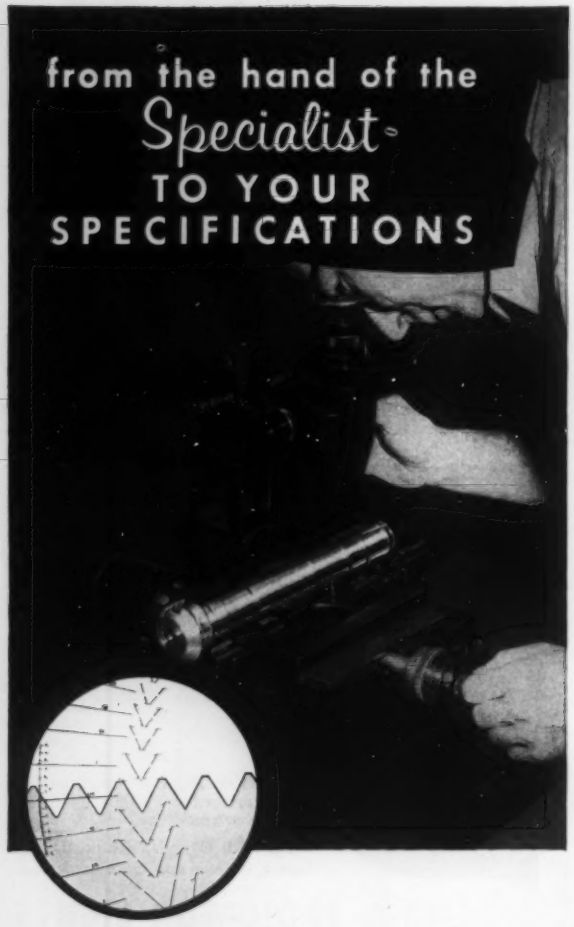
Circle 654 on page 19



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In Alloys • Stainless • Carbon • Bronze

Sharp eyes, made sharper by scientific instruments, verify microscopic details of thread accuracy at Erie Bolt & Nut Company. This is but one proof of the painstaking craftsmanship your own fastener specifications receive from the hands of Erie specialists. Fasteners to resist corrosion, extremes in temperature and tensile stresses to your specifications have been our exclusive job for almost half a century. Send us your specifications for prompt estimate.

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Circle 655 on page 19

CONTROL SYSTEMS

ENGINEERED WITH

FLEXIBLE "BALL BEARING"

Controlex

PUSH-PULL REMOTE CONTROLS

SEE OUR BOOTH

No. 1430

MAY 20-23

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WHITE PLAINS, NEW YORK

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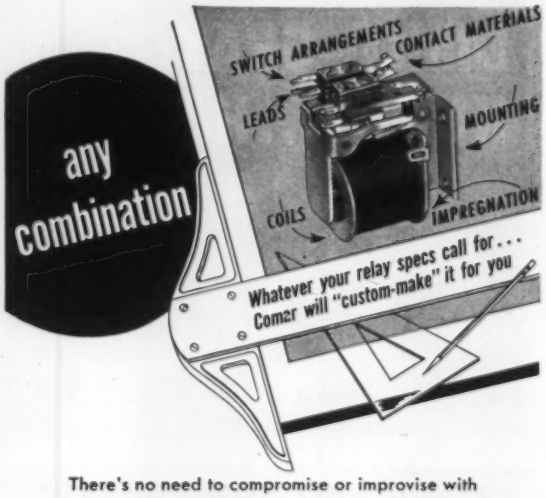


There's no need to compromise or improvise with ordinary stock relays. Comar can supply whatever combination of switches, contacts, coils, leads and mountings you need. Custom-made to match your product, installation is easier, performance is better, cost is surprisingly low. Inquiries invited.

Comar ELECTRIC COMPANY

3349 ADDISON ST., CHICAGO 18, ILLINOIS

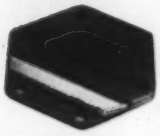
RELAYS • SOLENOIDS • COILS • SWITCHES • HERMETIC SEALING

Circle 657 on page 19

Stalwart silicone parts are solving more and more engineering problems for more and more products

7929-SR

Specially recommended for high and low temperature applications



Silicone rubber parts by Stalwart are solving problems every day . . . and costs are being cut too!

Time and again, Stalwart Engineers have and will replace costly metal constructions forced on design engineers because of the limited thermal stability of organic rubbers.

Stalwart is prepared to produce precision parts from a variety of Silicone rubber stocks to meet your individual specifications. These parts will retain rubber-like properties at temperatures from −130° to +600° F. They will have excellent dielectric properties and resist compression set.

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RUBBER COMPANY
180 Northfield Road • Bedford, Ohio

Manufacturing Plants In Bedford, Ohio and Jasper, Georgia
Main Offices:
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Circle 658 on page 19

ARROW JET MIST Generator

Utilizes machine tool SUMP and SUMP PUMP

NO—Pressurized Coolant Tank
NO—Special Spray Heads
NO—Pressure Regulators
NO—Control Panel NO—Gauges

MODEL M-100 JET MIST GENERATOR now provides for an inexpensive, fast set-up method for cooler cutting at higher speeds with longer tool life at lower costs.

Simply and easily mounted to all types of machine tools and metal working machinery.

Send for Bulletin MG-1056.

ARROW TOOLS, INC.
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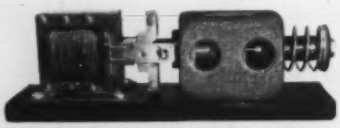


Bachman S-633, 3-way, 3 port valve for 200 psi.
¼ inch.....$12.75 ½ inch.....$16.50

- SPS ports with orifice up to .2 sq. in.
- Ports interchangeable for supply or exhaust.
- Standard O-ring seals.
- Constant duty AC solenoids with optional cover. (Inrush 4 amps. holding, 25 watts at 115 volts)
- Illustrated valve 8" long, weighs 2 lbs. and mounts in any position. Many other models in stock.

Don't Fail To See This Valve

AT THE DESIGN SHOW

If you are looking for low cost dependability, here is a constant duty direct solenoid valve for 200 psi which has proven its performance with hundreds of users. Bodies are machined from tough canvas-base phenolic with ports perpendicular to the laminations. These valves give millions of cycles of quiet and trouble-free service because the resilient construction quietly absorbs the kind of punishment that damages harder materials.

With these units you can operate, check or cushion cylinders. Use them for many combinations of manual or automatic control.

You can see Bachman Valves at the Design Show or order a trial unit with our guarantee of satisfaction. Write for Bulletin M-7 describing our complete line of controls.

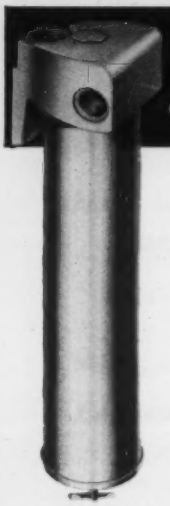
BACHMAN CONTROL VALVES BRISTOL TENNESSEE

John D. Bachman & Company

Sparger Lane Bristol, Tennessee

Circle 660 on page 19

Protect air-operated equipment with the low-cost DeVilbiss



Dirt, Moisture, & Oil Separator

Model HRE-501

Delivers up to 50 cfm of air for pneumatic tools, blow guns, air-operated controls, clutches and cylinders.

Permanent-type air cleaner and dirt filter is used. All-metal centrifugal water and oil eliminator requires no attention. Convenient bottom valve for draining off sediment and liquids.

Corrosion resistant—built to operate with up to 250 psi air. Has built-in mounting bracket. Write today for spec sheet.

DEVILBISS

THE DEVILBISS COMPANY
Toledo 1, Ohio

BRANCH OFFICES IN PRINCIPAL CITIES

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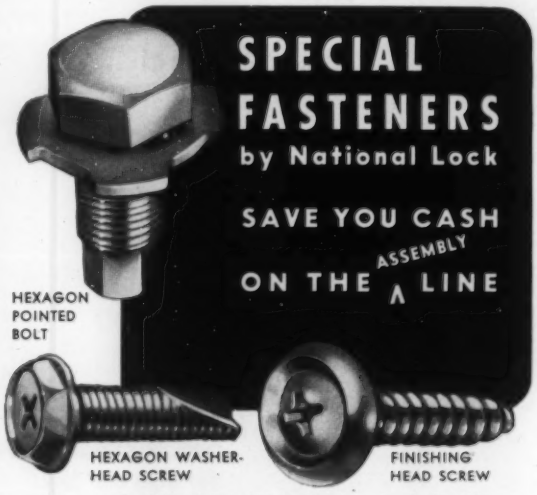

Specially designed fasteners save production time and assembly headaches. If your "specs" call for a one-piece screw and finishing washer, or a hexagon pointed bolt (allows adjustment after head has been covered in assembly), then look to National Lock. We will work closely with you in developing quality screws and bolts to meet your requirements.

NATIONAL LOCK COMPANY
Rockford • Illinois

Circle 662 on page 19

Design Manual

"MECHANICAL ADJUSTABLE-SPEED DRIVES"

Parts I & II
by Leo F. Spector

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write Readers Service Dept. MACHINE DESIGN

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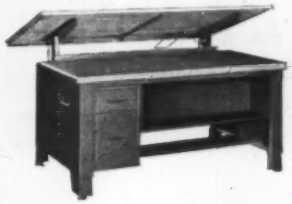

The MAY-O-MATIC Drafting Table

A table the draftsman will enjoy. A touch of a lever enables him to adjust for table height and top slope. He can reach easily any part of his drawing; and he can change his working position at his convenience.

Send today for literature describing the May-O-Matic table. Ask also for the 4-Post steel base table.

STEEL 4-POST TABLE

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601 No. Commerce St.
Sheboygan, Wisconsin

MAYLINE

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Circle 663 on page 19

DURA PLASTIC *Teflon* packing for chemicals

DURA PLASTIC
STYLE 666 F
Die-Molded Rings

DURA PLASTIC
STYLE 66 F
Spiral

A Completely Lubricated TEFLON PACKING

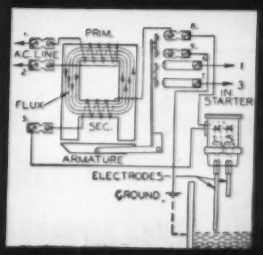
Durametallic's answer to sealing corrosive fluids—DURA PLASTIC *TEFLON* PACKING. It provides long uninterrupted sealing on all liquids except molten alkali metals and some flourine compounds in the higher temperatures. Particularly suitable for packing rods, shafts and stems on processing equipment handling hot caustics, acids, alkalies or organic solvents from -90°F. to 450°F. Supplied in die-molded ring or spiral form.

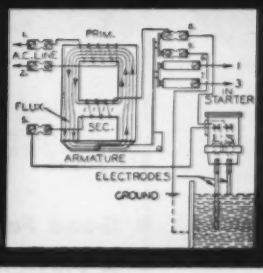
WRITE FOR DURA PLASTIC TEFLON PACKING BULLETIN 461 MD

DURAMETALLIC CORPORATION
KALAMAZOO, MICHIGAN

Circle 664 on page 19

LIQUID LEVEL CONTROL *with the* B/W RELAY





Type LH Relay
for
Pump Down Control

POSITIVE AND DEPENDABLE

The B/W system of liquid level control consists of a transformer type induction relay and a holder for one or two electrodes, depending on the desired operation and the type of relay used. The relay incorporates a primary or line voltage coil connected to a permanent source of alternating current, and a secondary or electrode circuit coil connected to the electrodes immersed in the liquid being controlled. Energizing the primary coil causes an induced voltage in the secondary coil; thus the secondary coil is never connected to the power line.

LIQUID IS ELECTRICAL CONDUCTOR

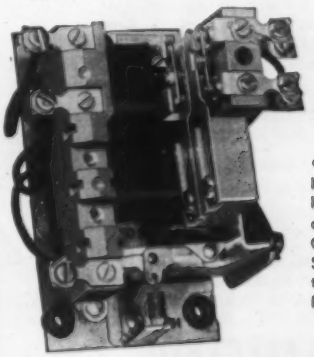
The liquid itself is the electrical conductor that completes the secondary circuit. When this secondary circuit is completed, by the liquid contacting both electrodes, the magnetic attraction set up in the legs of the relay core causes the armature to close, and open or close the load contacts. A built-in holding circuit maintains this contact until a predetermined fall in liquid level breaks the circuit. By adjusting the electrode settings, the range of operation can be controlled.

FOR PUMP UP and PUMP DOWN APPLICATIONS, SIGNALS and ALARMS

B/W relays are designed for either pump up or pump down operation. In addition, by using a single electrode they are well suited for signal and alarm applications.

NO MOVING PARTS

The complete absence of moving parts in the liquid insures long and trouble-free performance. Because of the very low current in the secondary circuit these relays are ideal for many switching jobs outside of the liquid level field.
Consult our engineering department on any special control applications.



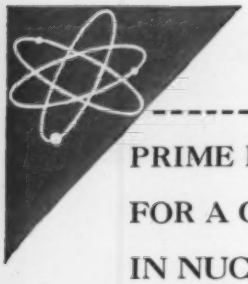
CATALOG on request

- It covers the complete line of B/W Induction Relays, Enclosures, Contactors and Starters, Multiple Pump Controls, Electrode Holders, Starter and Relay Combinations, Special Controls and Panels.

B/W CONTROLLER CORPORATION
2180 E. Maple Road, Birmingham, Mich.

FIRST IN THE FLOATLESS CONTROL FIELD

Circle 665 on page 19



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PRIME REQUISITES FOR A CAREER IN NUCLEAR FLIGHT PROPULSION

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- **A Flexible Point of View**

Developing an atom-powered engine requires the combined efforts of professional men from many technical areas.

If you have from 1 to 5 years' experience General Electric will provide the specialized knowledge necessary to apply your skills to the nuclear propulsion project here—already in the product stage.

We start you right in with assignments in project areas like these:

- **THERMODYNAMICS and CYCLE ANALYSIS**
- **STRESS and WEIGHT ANALYSIS**
- **SHIELD DESIGN**
- **FLUID FLOW**
- **POWER PLANT COMPONENTS**
- **HEAT TRANSFER**
- **REACTOR DESIGN and STRUCTURE**
- **REMOTE HANDLING**
- **AIRFRAME and STRUCTURES**

In-plant seminars and expert supervision will thoroughly ground you in the basics of nucleonics technology. You'll have access to such complex facilities as an engine test cell and digital and analog computers. And you can take graduate courses on a Full Tuition Refund Plan.

COMPREHENSIVE BENEFITS
FREQUENT MERIT REVIEWS
RELOCATION EXPENSES PAID

Choice of two locations:
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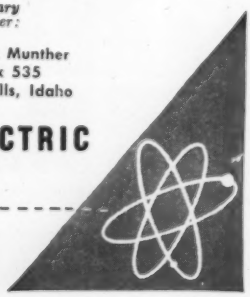

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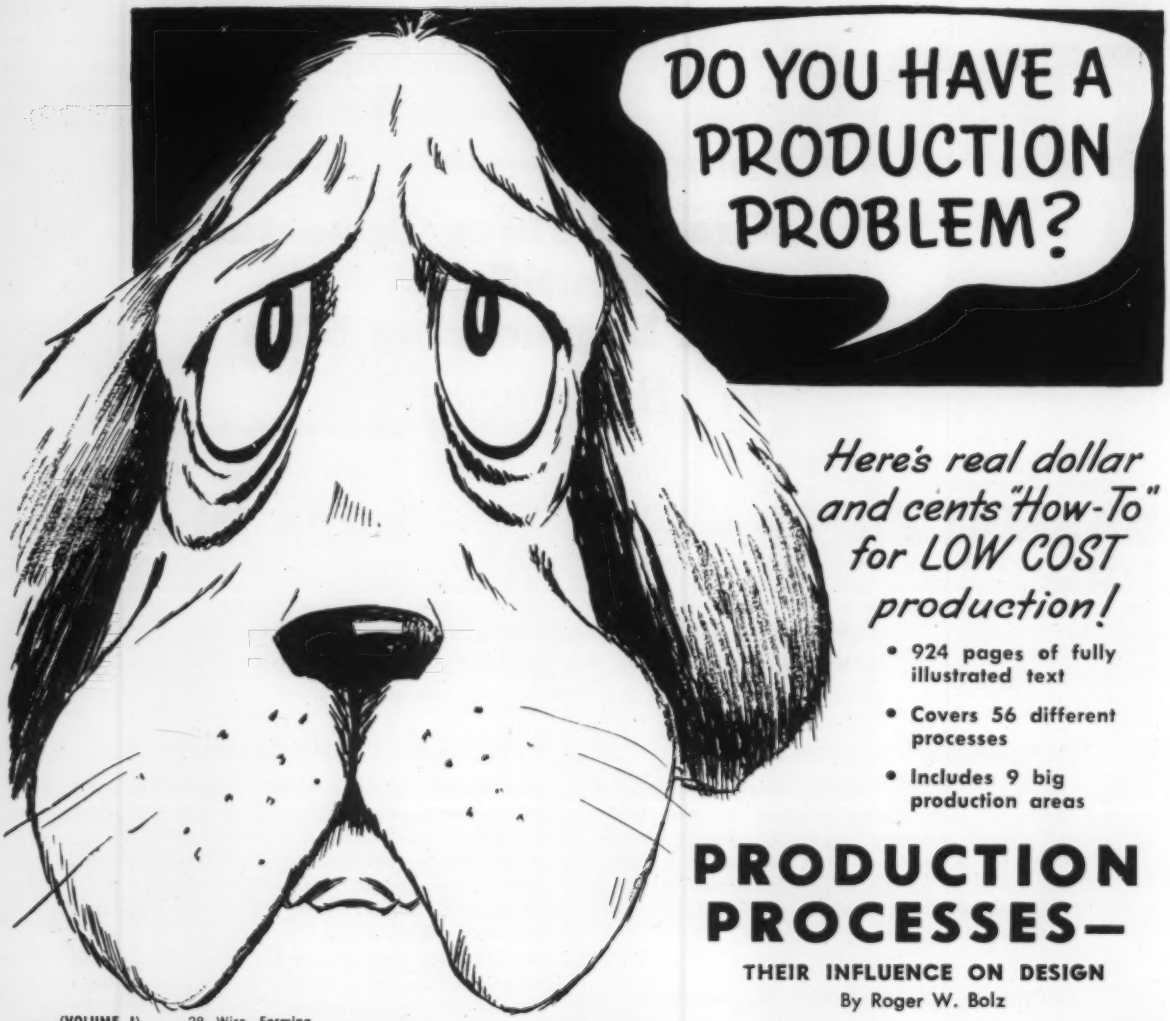

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47. Rubber Molding
48. Ceramics Molding

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Advertising Index

Abart Gear & Machine Co. 86
Accurate Spring Manufacturing Co. 248
Acme Chain Corporation 232
Acushnet Process Co. 254
Adel Precision Products, A Division of General Metals Corporation 236
Aeroquip Corporation 247
Aetna Ball & Roller Bearing Co., Division of Parkersburg-Aetna Corporation 46
Air-Maze Corporation 329
Ajax Flexible Coupling Co., Inc. 304
Alemite, Division of Stewart-Warner Corporation 1
Allegheny Ludlum Steel Corporation 65
Allied Wheel Products, Inc. 332
Allis-Chalmers, General Products Division 203
Allis, Louis, Co., The 100, 101
Aluminum Company of America 330, 331
American Blower Division of American Standard 104
American Brakeblok Division, American Brake Shoe Co. 333
American Brake Shoe Co., American Brakeblok Division 333
American Brake Shoe Co., Denison Engineering Division 306, 307
American Brass Co., The, American Metal Hose Division 68, 69
American Metal Hose Division, The American Brass Co. 68, 69
American Steel & Wire Division, United States Steel Corporation 283
Ampco Metal, Inc. 321
Armour Research Foundation of Illinois Institute of Technology 342
Armstrong Cork Co., Industrial Division 27
Arwood Precision Casting Corporation 32
Arrow Tools, Inc. 339
Atlantic Metal Hose Co., Inc. 335
Auburn Manufacturing Co., The 36

Bachman, John D., Co. 340
Baldor Electric Co. 267
Barber-Colman Co. 297
Barksdale Valves 324
Barry Controls, Inc. 294
Bellows Co., The 273
Berger Division, Republic Steel 288, 289
Bijur Lubricating Corporation 280
Bishop, J., & Co., Platinum Works, Stainless Steel Products Division 314
Blood Brothers Machine Division, Rockwell Spring and Axle Co. 279
Borg-Warner Corporation, Pesco Products Division 212, 213
Borg-Warner Corporation, Wooster Division 212, 213
Boston Gear Works 195
Bowser, Inc. 332
Brad Foote Gear Works, Inc. 214
Brammer Corporation 331
Brevel Products Corporation 290
Briggs Filtration Co., The 272
Briggs & Stratton Corporation 95
Bristol Co., The, Socket Screw Division 327
Brooks & Perkins, Inc. 38
Bruning, Charles, Co., Inc. 9
Burndy Corporation 51
B/W Controller Corporation 341

Cambridge Wire Cloth Co., The 260
Camloc Fastener Corporation 194
Carpenter Steel Co., The 71
Carr Fastener Co., Division of United-Carr Fastener Corporation 301
Century Electric Co. 265
Chicago Rawhide Manufacturing Co. 2
Chrysler Corporation, Amplex Division 57
Cincinnati Gear Co., The 228
Circle Seal Products Co., Inc. 330
Clark Controller Co., The 4
Columbia-Geneva Steel Division, United States Steel Corporation 58, 59, 283
Comar Electric Co. 338
Commercial Shearing and Stamping Co. 106
Continental-Diamond Fibre, A Subsidiary of The Budd Co. 52
Continental Rubber Works 300
Controlex Corporation of America 338
Copperweld Steel Co., Ohio Seamless Tube Division 191
Copperweld Steel Co., Steel Division 23
Cramer Posture Chair Co., Inc. 252
Crane Packing Co. 302
Crucible Steel Company of America 325
Curtiss-Wright Corporation, Metals Processing Division 98

Darling Valve & Manufacturing Co. 305
Delron Co., Inc., The 319
Denison Engineering Division, American Brake Shoe Co. 306, 307
Denison, R. B., Manufacturing Co. 298
Detroit Bevel Gear Co. 286
Detroit Power Screwdriver Co. 240
DeVilbiss Co., The 340

Dialight Corporation 337
Diamond Chain Co., Inc. 83
Dimco-Gray Co. 337
Dixon Automatic Tool, Inc. 292
Dodge Manufacturing Corporation 210, 211
Doehler-Jarvis Division of National Lead Co. 48, 49
Driv-Lok Pin Co. 331
Duff-Norton Co. 310
Durakool, Inc. 272
Durametallic Corporation 341
Dynamatic Division, Eaton Manufacturing Co. 66

Eastman Kodak Co., Graphic Reproduction Division 199
Eastman Manufacturing Co. 72
Eaton Manufacturing Co., Dynamatic Division 66
Eaton Manufacturing Co., Reliance Division 293
Elastic Stop Nut Corporation of America 308
Elco Tool and Screw Corporation 332
Electric Steel Foundry Co. 259
Electric Wheel Co., Division of The Firestone Tire & Rubber Co. 280
Electro-Flex Heat, Inc. 330
Equipment Engineering Co. 250
Erie Bolt & Nut Co. 338
Ex-Cell-O Corporation, Retec Division 251

Fafnir Bearing Co., The 16
Fairbanks, Morse & Co. 50
Falk Corporation, The 97
Farrel-Birmingham Co., Inc. 256
Federal-Mogul-Bower Bearings, Inc., Federal-Mogul Division 25
Federal-Mogul Division, Federal-Mogul-Bower Bearings, Inc. 25
Federal Pacific Electric Co. 244
Federal Tool & Manufacturing Co. 258
Fellows Gear Shaper Co., The 39
Felters Co., The 313
Fenwal, Inc. 222, 223
Firestone Tire & Rubber Co., The, Electric Wheel Co. Division 280
Flick-Reedy Corporation, Miller Fluid Power Division 70
Flick-Reedy Corporation, Tru-Seal Division 326
Foote Bros. Gear and Machine Corporation 284
Formsprag Co. 90
Furnas Electric Co. 26

Gardner-Denver Co. 303
Garlock Packing Co., The 47
Gast Manufacturing Corporation 276
Gates Rubber Co., The ..... Inside Front Cover
Gear Grinding Machine Co., The 295
Gearmonics Corporation 244
General Controls Co., Industrial Controls Division 239
General Electric Co. 74, 75, 342
General Metals Corporation, Adel Precision Products Division 236
General Motors Corporation, New Departure Division 11
General Motors Corporation, Hyatt Bearings Division 54, 55
General Motors Corporation, Saginaw Steering Gear Division 231
Gits Bros. Manufacturing Co. 237
Gleason Works 207
Gray Iron Founders' Society, Inc. 221
Gries Reproducer Corporation 318
Groov-Pin Corporation 334
Guardian Products Corporation, Coupling Division 314

Haloid Co., The 333
Hamilton Foundry and Machine Co., The 285
Hannifin Corporation 78
Hansen Manufacturing Co., Inc. 94
Hansen Manufacturing Co., The 241
Hassall, John, Inc. 218
Haynes Stellite Co., A Division of Union Carbide and Carbon Corporation 45
Heim Co., The 60
Heli-Coil Corporation 315
Horsburgh & Scott Co., The 238
Houdaille Industries, Inc., Manzel Division 287
Hubbell, Harvey, Inc. 196
Hyatt Bearings Division, General Motors Corporation 54, 55
Hydraulic Press Manufacturing Co., The, A Division of Koehring Co. 202

Illinois Tool Works, Spiroid Division 29
Imperial Brass Manufacturing Co., The 299
Imperial Pencil Tracing Cloth Co. 323
Industrial Retaining Ring Co. 327
Ingersoll-Rand 230
International Business Machines Corporation 343
International Research and Development Corporation 216

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Advertising Index

Johnson, Carlyle, Machine Co., The 309

Kaydon Engineering Corporation, The 21
Kennametal, Inc. 266
Koehring Co., The Hydraulic Press Manufacturing Co. Division 202
Koppers Co., Inc. 64

Landis & Gyr, Inc. 278
Lehigh Chemical Co. 262
Leiman Bros., Inc. 328
Lepel High Frequency Laboratories, Inc. 320
Lewellen Manufacturing Co. 15
Lincoln Electric Co., The 209
Link-Belt Co. 7
Littleford Bros., Inc. 290
L & L Manufacturing Co. 323
Logansport Machine Co., Inc. 197
Lord Manufacturing Co. 263
Lovejoy Flexible Coupling Co. 255

McGill Manufacturing Co., Inc. 189

Mac Lean-Fogg Lock Nut Co. 37
Manhattan-Rubber Division, Raybestos-Manhattan, Inc. 268, 269
Manzel, A Division of Houdaille Industries, Inc. 287
Master Electric Co., The ..... Inside Back Cover
Maurey Manufacturing Corporation 317
Mayline Co. 341
Mead Specialties Co. 243
Meehanite Metal Corporation 270, 271
Miller Fluid Power Division, Flick-Reedy Corporation 70
Minnesota Mining and Manufacturing Co., Adhesives and Coatings Division 67
Minnesota Rubber and Gasket Co. 281
Morganite, Inc. 198

National Acme Co., The, Electrical Manufacturing Division 235
National Lead Co., Doehler-Jarvis Division 48, 49
National Lock Co. 340
National Supply Co., The, Industrial Products Division 234
National Tube Division, United States Steel Corporation 283
National Vulcanized Fibre Co. 103
New Departure, Division of General Motors Corporation 11
New Jersey Zinc Co., The 108
New York Belting & Packing Co. 193
Norgren, C. A., Co. 77
Northrop Aircraft, Inc. 316
Nutt-Shel 278

Ohio Gear Co., The 226
Ohio Seamless Tube Division of Copperweld Steel Co. 191
Ortman-Miller Machine Co. 91

Pacific Automation Products, Inc. 40
Parkersburg-Aetna Corporation, Aetna Ball & Roller Bearing Co. Division 46
Perkins Machine and Gear Co. 246
Perspective, Inc. 298
Pesco Products Division, Borg-Warner Corporation 212, 213
Pheoll Manufacturing Co., Voi-Shan Manufacturing Co. Division 312
Phillips Control Corporation 258
Pneu-Trol Devices, Inc. 334
Polymer Corporation of Pennsylvania, The 192
Pope Machinery Corporation 31
Potter & Brumfield, Inc. 219
Pratt & Whitney Co., Inc. 228, 229
Price, D. W., Corporation 336

Raybestos-Manhattan, Inc., Manhattan Rubber Division 268, 269
Raybestos-Manhattan, Inc., Packing Division 268, 269
Redmond Co., Inc. 205
Reeves Pulley Co., Division of Reliance Electric and Engineering Co. 274
Reliance Division, Eaton Manufacturing Co. 293
Reliance Electric and Engineering Co. 261
Reliance Electric and Engineering Co., Reeves Pulley Co. Division 274
Republic Steel, Berger Division 288, 289
Reuland Electric Co. 87
Revere Copper and Brass, Inc. 53
Robbins & Myers, Inc. 201
Rockwell Spring and Axle Co., Blood Brothers Machine Division 279
Rockwood Pulley Manufacturing Co., Inc. 323
Rogers Corporation 277
Rollway Bearing Co., Inc. 296
Rosan, Inc. 328

Saginaw Steering Gear Division, General Motors Corporation 231
Schrader's, A., Son, Division of Scovill Manufacturing Co., Inc. 227
Scovill Manufacturing Co., Inc., A. Schrader's Son Division 227
Set Screw & Manufacturing Co. 270
Shell Oil Co. 85
Sierra Engineering Co. 329
Simmons Fastener Corporation 73
Simplatrol Products Corporation 335
SKF Industries, Inc. 34, 35
Skinner Electric Valve Division 79
Southwest Products Co. 334
Spiroid Division of Illinois Tool Works 29
S-P Manufacturing Corporation, The 249
Square D Co. 80, 81
Stalwart Rubber Co. 339
Standard Pressed Steel Co., Flexloc Locknut Division 215
Standard Pressed Steel Co., Unbrako Socket Screw Division 92, 93
Stanpat Co. 30
Stewart, F. W., Corporation 262
Stewart-Warner Corporation, Die Casting Division 253
Strong, Carlisle & Hammond, Mac-it Screw Division 322
Superior Carbon Products, Inc. 242
Synthane Corporation 225

TA Manufacturing Corporation 335
Tennessee Coal & Iron Division, United States Steel Corporation 58, 59, 283
Thompson-Bremer & Co. 257
Timken Roller Bearing Co., The ..... Back Cover
Torrington Co., The 13
Torrington Manufacturing Co., The 245
Townsend Co. 33
Tru-Seal Division, Flick-Reedy Corporation 326
Tuthill Pump Co. 275

Union Carbide and Carbon Corporation, Haynes Stellite Co. 45
Union Chain and Manufacturing Co., The 200
Unitcast Corporation 264
United-Carr Fastener Corporation, Carr Fastener Co. Division 301
United Shoe Machinery Corporation 291
U.S. Axle Co., Inc., The 56
United States Graphite Co., The, Division of The Wickes Corporation 88, 89
United States Steel Corporation, Subsidiaries 58, 59, 283
United States Steel Export Co. 58, 59, 283
United States Steel Supply Division, United States Steel Corporation 58, 59, 283
Universal Ball Co. 250
Universal Drafting Machine Corporation 326

Vacuum Metals Corporation, Division of Crucible Steel Company of America 82
Valvair Corporation 102
Vari-Typer Corporation 329
V. & E. Manufacturing Co. 337
Vickers, Inc., Division of Sperry Rand Corporation 99
Victor Manufacturing & Gasket Co. 233
Voi-Shan Manufacturing Co., A Division of Pheoll Manufacturing Co. 312
Vulcan Electric Co. 252

Waldes Kohinoor, Inc. 347
Ward Leonard Electric Co. 217
Warner Electric Brake & Clutch Co., Industrial Division 62, 63
Warren Pumps, Inc. 282
Washington Steel Corporation 84
Watts Regulator Co. 224
Weatherhead Co., The 96
Webster Electric, Oil Hydraulics Division 61
Westinghouse Electric Corporation 41, 42, 43, 44, 105
Whitney Chain Co. 107
Wickes Corporation, The, The United States Graphite Co. Division 88, 89
Wiegand, Edwin L., Co. 28
Winsmith, Inc. 220
Wooster Division, Borg-Warner Corporation 212, 213
Worthington Corporation 311

Zenith Electric Co. 328

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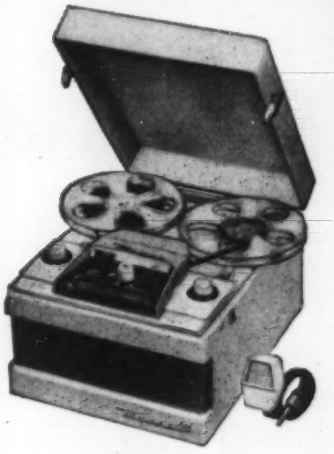

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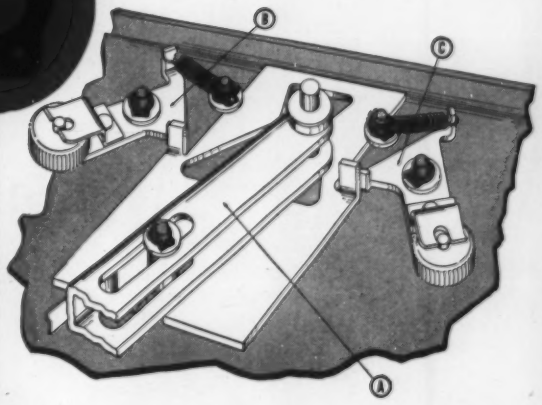

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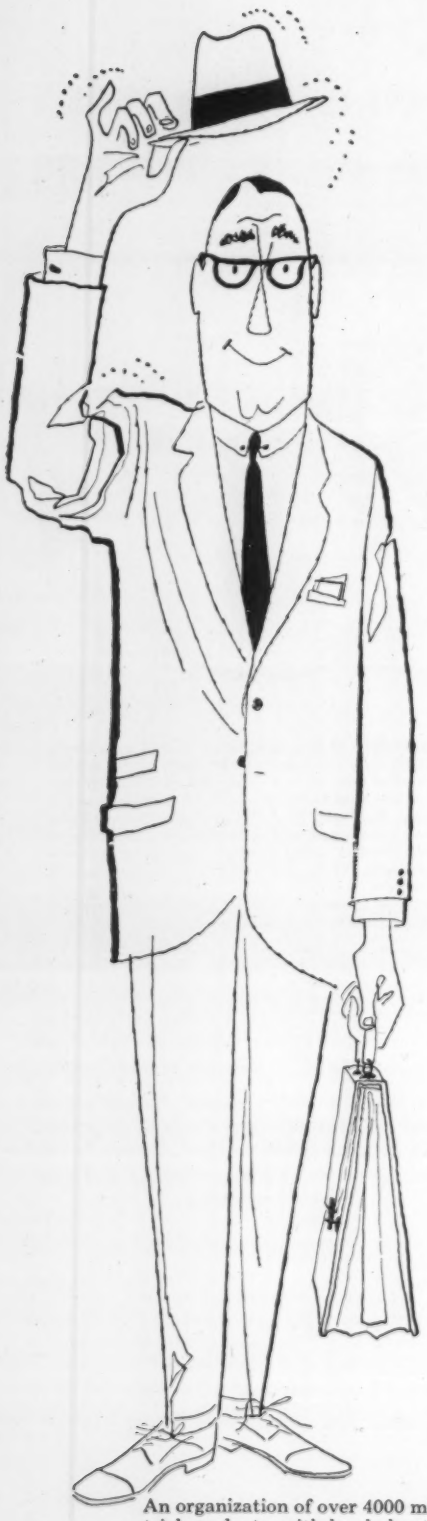

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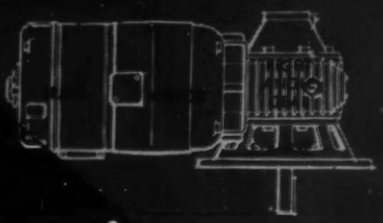
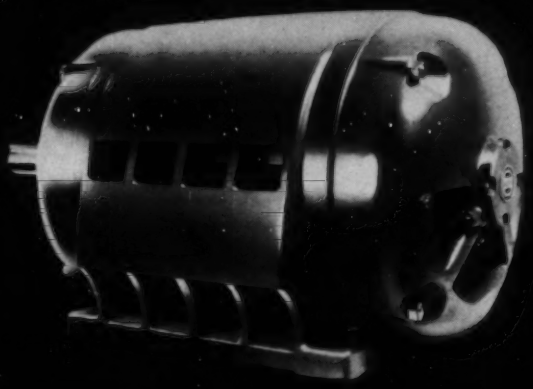
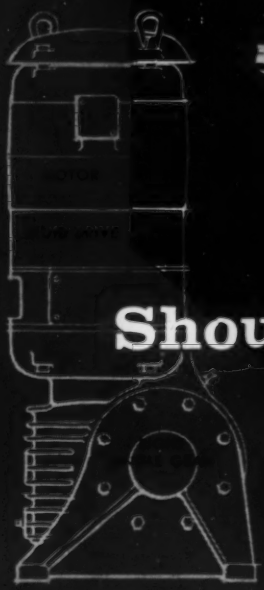
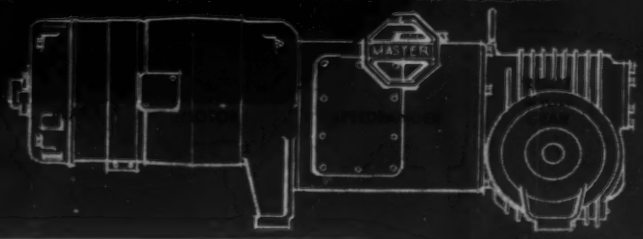


Your specialized drive requirements





Should meet their Master



Master Units Combine into Engineered, Customized Package Drives—Providing the Right Shaft Speed, the Right Construction Features, the Right Mounting. Why Put Up With Makeshift Assemblies?

Engineers and Manufacturers of

Electric Motors	**⅛ to 400 H.P.**
Gearmotors	**⅛ to 125 H.P.**
Variable Speed Drives	**⅛ to 30 H.P.**
Unibrake Motors	**⅛ to 150 H.P.**
Fluid Drive Motors	**½ to 15 H.P.**

Alternating current motors, direct current motors, generators . . . open, enclosed, explosion proof . . . with 5 types of gear reducers . . . with electric brakes . . . with mechanical or electronic variable speed units . . . with fluid drives . . . Master has them all and so can be completely impartial in helping to select the one best drive for you.

MASTER ELECTRIC MOTORS

THE MASTER ELECTRIC COMPANY, Dayton 1, Ohio

Produces automotive parts automatically ...with TIMKEN® bearings, the precision is automatic, too

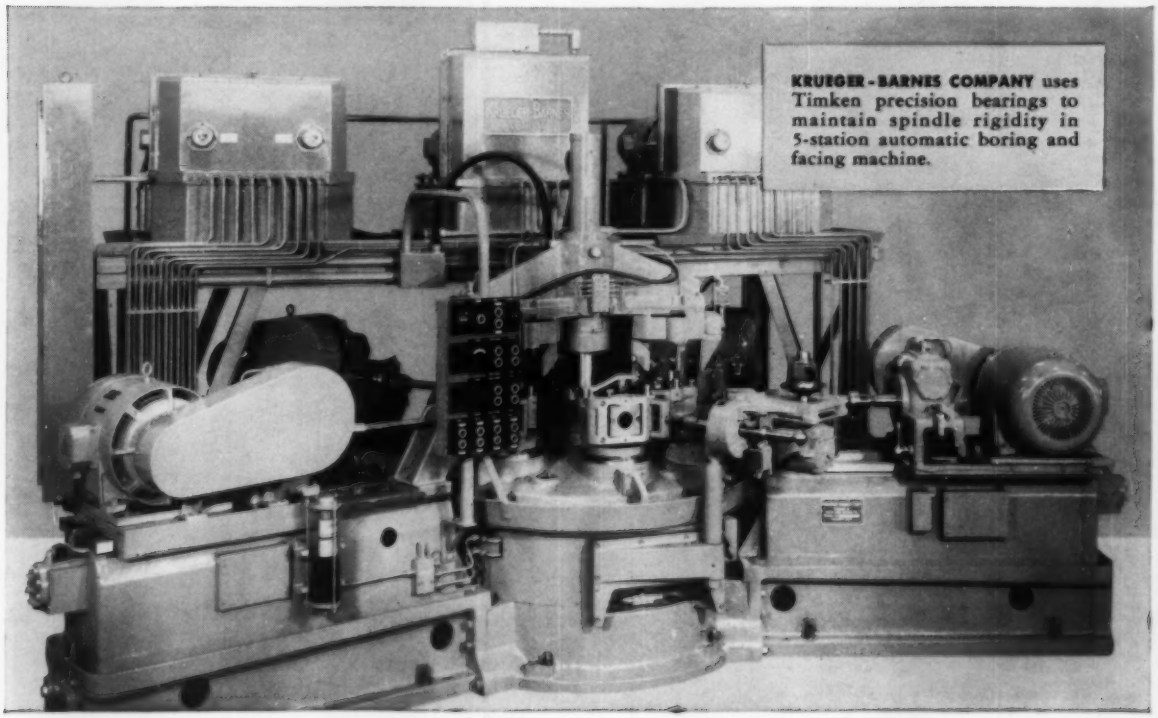
KRUEGER-BARNES engineers designed this 5-station milling and boring machine to produce automotive differential cases semi-automatically. To be sure its precision was automatic, too, they mounted the 5 spindles on 10 Timken® tapered roller bearings. Timken bearings take the work loads, keep the spindles rigid through hour after hour, shift after shift of high-speed operation. And they do it with a minimum of attention and maintenance.

Timken bearings maintain spindle rigidity because their tapered design lets them take both radial and thrust loads in any combination. And full line contact of rollers and races in Timken bearings gives them extra load-carrying capacity.

Timken bearings are designed by geometrical law to have true rolling motion and precision manufactured to live up to their design. Manufactured with an incredibly smooth surface finish, Timken bearings virtually eliminate friction, help keep machines on the go with less maintenance.

Since Timken bearings are engineered for the job, precision manufactured and made of special analysis Timken fine alloy steels, they normally last the life of the machine. In machine tools as in all machinery, wherever wheels and shafts turn, Timken bearings are your No. 1 value. When you build or buy machines, specify Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



KRUEGER-BARNES COMPANY uses Timken precision bearings to maintain spindle rigidity in 5-station automatic boring and facing machine.

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD

Circle 403 on page 19